Space flight - exploration
& Rocket
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184 P.

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PARTIAL BIBLIOGRAPHY

ON

ARTIFICIAL SATELLITES AND SPACE STUDIES

Langley Aeronautical Laboratory

March 1958

SPACE Flight — Exploration

NOTICE

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ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.)

1958

A GENERALIZED OPTIMIZATION PROCEDURE FOR N-STAGED MISSILES. Leon Weisbord. Jet Propulsion, v.28, no.3, Mar.1958, p.164-167. This report is an extension of the Goldsmith report and outlines a simple method for determining the optimum weight distribution for a staged rocket with different structural factors and propellant specific impulses in each stage. It is applicable for a rocket of any number of stages, and is not limited to either a horizontal or vertical trajectory. The report can be used in a first design estimate to determine the weight distribution among the various stages and the weight breakdown within each stage.

POWER-LIMITED FLIGHT—OPTIMIZATION IN GRAVITATIONAL FIELDS. (Lecture for course - Space Technology). Jack H. Irving. University of California - Lecture 5B, Feb.17-21,1958.

FLIGHT PERFORMANCE OF A ROCKET IN STRAIGHT-LINE MOTION. (Lecture for course - Space Technology). Martin Summerfield. University of California - Lecture 2B, Jan.20-22,1958.

PROJECT FAR SIDE LAUNCHINGS. John L. Cramer. (Presented at 26th annual meeting, IAS, New York, Jan.27-30,1958). Institute of the Aeronautical Sciences, Preprint 824. (CN-58766)

TRAJECTORY OPTIMIZATION OF POWERED FLIGHT. (Lecture for course - Space Technology). Burton D. Fried. University of California - Lecture 2B, Jan.20-22,1958.

STEERING OF AN ASCENT ROCKET FOR MAXIMUM CUTOFF VELOCITY. W. H. Foy. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31,1958. The general solution to the variational problem of specifying the thrust-attitude program to maximize the cutoff velocity of an ascending rocket with a known thrust-acceleration time history is obtained in the form of a set of partial differential equations.

OPTIMUM BURNING PROGRAMME AS RELATED TO AERODYNAMIC HEATING FOR A MISSILE TRAVERSING THE EARTH'S ATMOSPHERE. Angelo Miele. (Presented at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957 and American Astornautical Society annual meeting, Jan.29-31,1958). Douglas Aircraft Co., Inc. SM-27236. The burning program for a rocket-powered missile moving along a rectilinear path is investigated in the light of the thermal effects induced by such a program on the missile skin. (N-55987).

ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.) - Continued

SATELLITE ASCENT VEHICLE GUIDANCE REQUIREMENTS. C. L. Keller. American Astronautical Soc., Annual meeting, held in New York. Jan.29-31,1958.

ÜBER EINE NÄHERUNGSMETHODE ZUR BERECHNUNG VON KREISBAHNRAKETEN. (Ger. text) Heinz H. Koelle. Raketentech. and Raumfahrtforsch. Jan.1958, p.8-12. Development of an approximate analytical method for the calculation of circular orbits of rocket vehicles. The method permits the determination, with a relatively small time expenditure, of design and performance parameters of a multistage rocket for flight missions which lead from the earth's surface into a circular orbit at arbitrary altitude around the earth. This method also leads to another simplified method for the calculation of long-range rocket vehicles. As an illustrative example the case of a three-stage circular-orbit rocket is treated.

EINFLUSSGRÖSSEN BALLISTISCHER FERNFLUGKÖRPER. (Ger. text). Oscar Scholze. Raketentech. u. Raumfahrtforsch. Jan.1958, p.2-8. Investigation of trajectory characteristics of missiles, rocket aircraft, and satellite-carrying rockets shows that trajectories of all three are similar and therefore could be produced by the same type of propulsion. Study includes: dimensional effects, the effects of acceleration, number of stages or boost units, and air resistance. Current developmental problems are briefly summarized.

1957

PROBLEMS OF LAUNCHING AN EARTH SATELLITE. I, II. Martin Summerfield. Journal of Astronautics, Nov., Dec.,1957, pp.18-21, 86-88, 34-36, 50, 51, 54. Discussion which includes orbit selection, launching energy requirements, frontal area density effects, and choosing an orbital altitude. An analysis is presented of flight performance, multistage techniques, and firing program for a vehicle capable of putting a 50-lb payload on the moon.

PLACING THE VANGUARD SATELLITE IN ORBIT. John P. Hagen. Interavia, v.12, no.12, Dec.1957, p.1245-1250. Description of U.S. satellites, launching vehicles, and launching program.

OPTIMIZATION CONSIDERATIONS FOR ORBITAL PAYLOAD CAPABILITIES. Heinz H. Koelle. (Paper given at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957.) American Rocket Society. Paper 491-57. Available information on components in Russian military rockets is used to deduce that the Russian orbital vehicle has a payload capability of several hundred pounds. The various parameters influencing the design concept of an orbital carrier vehicle are

ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.) - Continued

enumerated. Bibliography of 71 references on orbits and trajectories, carrier vehicles and satellites. (CN-57896)

THE ESTABLISHMENT OF AN ARTIFICIAL SATELLITE OF THE EARTH IN ORBIT. D. Ye Okhotsimskii and T. M. Eneyev. Paper given at the 8th International Astronautical Congress, Barcelona, Oct.6-12,1957. A mathematical investigation of the optimization of the flight programme of the rocket vehicle used to establish an artificial satellite.

CERTAIN VARIATIONAL PROBLEMS CONNECTED WITH LAUNCHING OF AN ARTIFICIAL EARTH SATELLITE. D. Ye Okhotsimskii and T. M. Eneyev. (Presented at Conference on Earth Satellites, Washington, D. C., Oct.2-5,1957). U.S. Joint Publications Research Service, Rept.187, p.1-45 (N-58836,pt.1). Translation from: Uspekhi Fizicheskikh Nauk, v.63, no.1a, Sept.1957, p.5-33. Discusses the problem of launching a satellite and putting it into an orbit.

THE SATELLITE LAUNCHING VEHICLE. Milton W. Rosen. Symposium on high altitude and satellite rockets. Held at College of Aeronautics, Cranfield, Approx. July 1957. Organized by British Interplanetary Soc., College of Aeronautics and Royal Aeronautical Soc. Listing the primary requirements for a satellite launcher, its size, weight and performance, which were governed by the satellite's weight and designed orbit. It is said that the 1,000 to 1 ratio of vehicle weight to payload weight would become smaller with larger vehicles.

ON THE POWERED FLIGHT TRAJECTORY OF AN EARTH SATELLITE. B. D. Fried. Jet Propulsion, June 1957, p.641-643. Comments on this paper by Theodore N. Edelbaum appear in Jet Propulsion, v.27, no.12, Dec. 1957, p.1260-1261. Theoretical investigation of the problem of programming the trajectory. A point-mass missile moving in a uniform gravitational field, with aerodynamic forces neglected, is considered in order to obtain the optimum trajectory by making the tangent of the angle ψ between the thrust vector and the horizontal a linear function of time. Result is valid for arbitrary time dependence of thrust and mass, including the discontinuities corresponding to staging.

SUPPORT REQUIREMENTS FOR THE VANGUARD SATELLITE LAUNCHING VEHICLE. Sears Williams. (Presented at ARS spring meeting, Washington, D. C., Apr.3-6,1957). American Rocket Society, Preprint 425-57. (CN-54955)

ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.) - Continued

LAUNCHING THE EARTH SATELLITE. N. Elliott Felt, Jr. Sperryscope, 1st Quarter, 1957, p.12-15.

THE CASE FOR THE LOW ACCELERATION SPACESHIP. H. F. Michielsen. Astronautica Acta, no.2, 1957, p.130-152. Analysis of the mechanics of the escape trajectories for low-acceleration propulsion. The method used involves inversion of the formulation of the problem, i.e.: a trial-and-error procedure is used to choose a probable trajectory, which is then used to compute the corresponding thrust components; if these components are economically justified in terms of fuel consumption, the trajectory is deemed feasible.

MASS RATIOS. A. V. Cleaver. Realities of Space Travel, Selected Papers of the British Interplanetary Society, edited by L. J. Carter, 1957, p.45-53.

TRAJECTORIES AND ORBITS OF THE VANGUARD SATELLITE. Benjamin Lepson. American Rocket Society. Preprint 429-57. (1957).

1956

THE PROBLEM OF GOODARD AND OPTIMUM THRUST PROGRAMMING. Frank D. Faulkner. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.43-52. Goodard's problem is that of sending a rocket to maximum altitude by choosing the thrust function properly. (N-58942)

LES POSSIBILITES DE LANCEMENT D'UN SATELLITE ARTIFICIAL FRANCAIS. (French text). E. Herrera. Genie Civil, v.133, no.19, Oct.1, 1956, p.349-355. Possibilities of launching French artificial satellite; altitude and orbit; point of departure of missile, its trajectory and direction; weight and utilization of satellite; relationship of mass; properties of satellite and characteristics of missile.

POWERED FLIGHT OPTIMIZATION. John S. Prigge, Jr. Taken from: Orbital and Satellite Vehicles, v.1 and v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally in the Summer of 1956, but being compiled into above book).

LUNAR INSTRUMENT CARRIER - TRAJECTORY STUDIES. Hans A. Lieske. Rand Corp. RM 1728, June 4, 1956.

A CALCULUS OF VARIATIONS SOLUTION OF GOODARD'S PROBLEM. G. Leitmann. Astronautica Acta, June 1956, p.55-62. Analysis of an optimum thrust program for a rocket to achieve given altitude with a given velocity and pay load, and with minimum fuel expenditure.

ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.) - Continued

FLIGHT MECHANICS OF ASCENDING SATELLITE VEHICLES. F. M. Perkins. Jet Propulsion, May 1956, p.352-358. Solution of the optimum vacuum stage thrust axis pitch program for a satellite using continuous thrust all the way from ground to orbit, with and explanation of trajectory optimization to minimize propellant consumption for a vehicle using a power-off coast up to the orbit, and of analog and digital computer techniques for trajectory calculations. Includes discussion of types of orbits and trajectories. Discussion covers auxiliary orbits and orbits of departure and arrival for astronautical expeditions, and the continuous and interrupted thrust types of trajectories.

A METHOD FOR CALCULATING THE MASS RATIOS OF STEP-ROCKETS. M. Vertregt. Journal of the British Interplanetary Society, v.15, no.2, Mar-Apr.1956, p.95-98.

PLACING THE SATELLITE IN ITS ORBIT. Milton W. Rosen. (Presented at Symposium on U.S. Earth Satellite Program - Vanguard of Outer Space, held at IRE National Convention, New York, Mar.19-22,1956). Institute of Radio Engineers, Proceedings, v.44, no.6, June 1956, p.748-751. IRE Convention Record, pt.1, 1956, p.103-107. Discusses method of launching and explanation of the reasons for selecting the adopted method. (CN-45812,pt.1).

ASCENT OF ORBITAL VEHICLES. Krafft A. Ehricke. Astronautica Acta, v.2, no.4, 1956, p.175-190. Comparison of an ascent into a satellite orbit along a minimum energy ellipse (elliptic ascent) with an ascent along an arc of an elliptic trajectory (ballistic ascent) where the satellite stage is transferred into the orbit at or near the summit. Analyzed are the basic energy requirements, thrust program, effects on the size of the stages, visibility, and the flight times. Basically the ballistic ascent compares unfavorably with the elliptic ascent because of the high transfer energy required at the summit point resulting in the need for transporting comparatively large quantities of material and propellant into orbital distance.

RELATIVISTIC ROCKET MECHANICS. (Relativistische Raketenmechanik). H. G. L. Krause. Astronautica Acta, v.2, no.1, 1956, p.30-47. Mechanics of special theory of relativity are extended to systems with timely changeable rest masses (rockets); theorem of impulse and energy examined as well as law of decrease of mass of rocket with optional acceleration in free space without outward power.

ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.) - Continued

1955

ON THE CALCULATION OF THE POWERED FLIGHT OF A LONG RANGE ROCKET SUPERVISED BY AN AUTOMATIC PILOT. J. M. J. Kooy. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

AN APPROXIMATE SOLUTION OF THE MOTION EQUATION OF A ROCKET AND APPLICATION TO THE DETERMINATION OF THE BEST BURNING TIME. R. Pennacchi. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug. 1955).

OPTIMUM LAUNCHING OF A ROCKET INTO AN ORBIT ABOUT THE EARTH. Derek F. Lawden. (Paper presented at 6th International Astronautical Congress, Copenhagen, Aug.5,1955). Astronautica Acta, v.1, no.4, 1955, p.185-190. Derivation and numerical integration of the equations governing the rocket trajectory in terms of the requirements of a minimum expenditure of fuel.

BALLOON-LAUNCHING AN EARTH SATELLITE ROCKET. Kurt R. Stehling. Aviation Age, v.24, no.1, July 1955, p.16-25. "Here is a proposal for a practical rocket vehicle." Specifications, designers' problems, boosters, stages, electrical power, and advantages are discussed.

POWERED ORBITS IN SPACE. G. F. Forbes. Journal of the British Interplanetary Society, v.14, no.2, Mar.-Apr.1955, p.85-87. Equations for powered space rocket given in form suitable for use on either digital or Bush differential analyzer.

1954

STATIONARY ROCKET TRAJECTORIES. Derek F. Lawden. Quarterly Journal of Mechanics and Applied Mathematics, v.7, pt.4, Dec., 1954, p.488-504. Calculation of conditions to be satisfied by trajectory joining two specified terminals in space, if it is to be stationary relative to fuel expenditure; rocket is supposed to be moving in general gravitational field and subject to aerodynamic forces which are known functions of velocity; theory illustrated by application to problem of optimum programming of fuel expenditure to reach given height.

THE INCREMENTAL-STEP ROCKET IN FREE SPACE. Hugh R. Wahlin. (Presented at 9th ARS annual meeting, New York, Nov.30-Dec.3, 1954). American Rocket Society. Paper 184-54. (CN-49376)

ON THE NOMENCLATURE OF THE WEIGHT FACTIONS OF STEP-ROCKET. Guido von Pirquet. Fifth International Astronautical Congress, Innsbruck, Aug.5-7,1954, p.162-168. (N-46768)

ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.) - Continued

CALCULATION OF STEP-ROCKETS. M. Vertregt. Fifth International Astronautical Congress, Innsbruck, Aug.5-7,1954, p.157-161. A simple system of notations and ratios is proposed for the calculation of step-rockets. Three ratios are used which are sufficient for basic calculations. All ratios are defined in such a manner that their values are greater than one; the equations derived from these ratios are simple and symmetrical. Some examples are given. (N-46768).

HIGH ALTITUDE LAUNCHING OF A SMALL ORBITAL VEHICLE. Kurt R. Stehling. American Rocket Society Paper 187-54. The gains achieved through the high altitude launching of small research rockets from Skyhook balloons led the author to consider the firing of a larger orbital vehicle from these altitudes. It is shown that such a launching scheme offers an advantage in missile weight and cost, particularly for high acceleration rate vehicles, through the reduction of aerodynamic drag.

THE INEXPENSIVE ATTAINMENT OF HIGH ALTITUDES WITH BALLOON-LAUNCHED ROCKETS. James A. Van Allen and Melvin B. Gottlieb. (Assisted by Office of Naval Res., Atomic Energy Commission, and Bur. of Aeronautics). In "Rocket Exploration of the Upper Atmosphere," Jour. of Atmospheric and Terrestrial Physics, 1954. (Papers read at conf. arranged by Upper Atmosphere Rocket Research Panel and Royal Soc. of London), (p.53-64). (N-33498).

THE VANGUARD SATELLITE LAUNCHING VEHICLE. N. Elliott Felt, Jr. Seventh International Astronautical Congress, Rome, 1956.

1953

INTEGRATION OF THE EQUATION OF MOTION OF A VERTICAL RISING ROCKET AFTER THE CESSATION OF FIRING WITHIN THE ATMOSPHERE. H. G. L. Krause. 4th International Astronautical Congress, held in Zurich, Aug.3-8, 1953. Integrates equation of motion of free flight of a vertically ascending rocket with consideration of air drag. An exponential atmospheric density decrease, a drag coefficient varying with the missile's velocity, and an exactly derived mean value for the gravitational acceleration, were used. The integrated equation of motion yielded formulae for the computation of altitude reached and the time of attaining maximum altitude.

MARGIN FOR ERROR. Milton W. Rosen and R. B. Snodgrass. (Presented at Fourth International Astronautical Congress, held in Zurich, Aug.3-8,1953). American Rocket Society Paper 98, 1953. High altitude rockets never achieve their full capabilities because of errors in adjustment before take-off and because of unforeseen variations in performance. Two avenues for

ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.) - Continued

improvement were suggested: to reduce the errors by an improvement in the design of rockets and to increase the margin.

1952

A FEW FUNDAMENTAL PROBLEMS OF MANNED VERTICAL TAKE-OFF. (Einige grundsatzliche Probleme des Senkrechtstarts). E. Bachem. (German text and English summary). Third International Astronautical Congress, Proceedings, Stuttgart, Sept.1-6,1952, p.89-96. The following is a survey on the results and experiences obtained from vertical guided launching of the "B.P. Natter" during 1944/45. A survey on the launching performances with pilotless, gyro-controlled missiles is given in detail. The first piloted vertical launching with Lt. Siebert as pilot and its failure are discussed. (N-53323)

FUNDAMENTAL REMARKS ON THE PROBLEM OF UNMANNED AND MANNED SPACE VEHICLES. (Grundsatzliches zur Frage des unbemannten und bemannten Raumfahrzeuges). A. Hjertstrand. (German text and English summary). Proceedings of the Third International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.70-73. When projecting a multi-step rocket, the common assumption is constant thrust for the various steps with the exception of the first step which has variable thrust. A comparison is drawn between two cases; A. constant acceleration for all steps, and B. constant thrust for the first step, thereafter constant acceleration. (N-53323).

CATAPULT TAKE-OFF. (Katapultstart). H. Kühme. (German text and English summary). Proceedings of the Third International Astronautical Congress, Stuttgart, Sept.1-6, 1952, p.106-110. The vertical takeoff hitherto used and resulting in the most favorable design of a rocket, is subject to a velocity loss of 8 to 10 percent for generally used fineness ratios (0.2 to 0.3). This velocity loss pertains to the firing of the first step which (for the present designs) reaches a burnout altitude between 40 and 50 km. The magnitude of this velocity loss ranges about 150 m/sec. As a result of this acting air drag, the payload of the last step of the satellite rocket is reduced by one half. (N-53323)

DROPPABLE STAGES MAY BOOST ROCKETS TO EARTH-CIRCLING ORBITS. C. T. Aubrey. (From paper: Practical aspects of space ship design and interplanetary travel.) (Presented at SAE Southern Calif. Section meeting at Los Angeles, Jan.10,1952.) Soc. Automotive Engineers Jour. v.60, no.9, Sept.1952, p.19-23. Discussion and data for 2,3,4,5-stage rockets; design of multiple stage rockets.

ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.) - Continued

1951

MINIMUM SATELLITE VEHICLES. Kenneth W. Gatland, Anthony M. Kunesch, and Alan E. Dixon. Second International Congress on Astronautics, held in London by British Interplanetary Society, Sept.3-8,1951. Published in Journal Nov.1951, p.287-294. Studies were made of four rocket vehicles designed to reach circumterrestrial close-orbits with various minimal payloads which conform to specific experimental requirements. All are considered as three-step rockets employing liquid oxygen/hydrazine, the fourth incorporating expendable-tanks.

OPTIMUM THRUST PROGRAMMING FOR A SOUNDING ROCKET. H. S. Tsien and Robert C. Evans. Jet Propulsion, v.21, no.5, Sept.1951, p.99-107. The problem of optimum thrust programming for a sounding rocket of minimum starting weight to reach specified height with given final weight and propellant characteristics is first formulated as a problem in variational calculus. The general solution for arbitrary drag function is given. The solution is then applied to two special cases, one with quadratic drag dependence on velocity and the other with linear drag dependence on velocity. Complete numerical data are given.

ENTRY INTO CIRCULAR ORBITS, PART 1 AND 2. Derek F. Lawden. Journal of the British Interplanetary Society, v.10, no.1, Jan.1951, p.5-17 (part 1). Journal of the British Interplanetary Society, v.13, no.1, Jan.1954, p.27-32 (part 2). Part 1 - A mathematical discussion of the problem of the transfer of a body from the earth's surface into a circular orbit above the earth. Part 2 - Discusses problems of navigating a rocket approaching planet from great distance. . . effect of varying line of approach and radius of circular orbit.

APPLICATION OF THE GENERAL TRAJECTORY EQUATIONS. G. F. Forbes. Journal of the British Interplanetary Society, v.10,1951, p.194-196.

FUNDAMENTAL DYNAMICS OF REACTION-POWERED SPACE VEHICLES. L. N. Thompson. Institution of Mech. Engineers, Proceedings, v.164, no.3, 1951, p.264-273. Briefly suggests that step rockets and space stations offer promising fields of investigation for interplanetary flights. Article deals mainly with escape velocity.

1950

ELECTROMAGNETIC LAUNCHING AS MAJOR CONTRIBUTION TO SPACE-FLIGHT. Arthur Charles Clarke. Journal of the British Interplanetary Society, v.9, no.6, Nov.1950, p.261-267. Use of electromagnetic accelerators

ASCENT TO ORBIT (Including problems of launching, take-off, optimum thrust, staging, powered trajectories, etc.) - Concluded

on moon to launch fuel mined there into suitable orbits around earth to moon.

TRAJECTORY OF POWERED ROCKET IN SPACE. G. F. Forbes. Journal of the British Interplanetary Society, v.9, no.2, Mar.1950, p.75-79. Mathematical analysis applicable to rocket in central force space under general condition of thrust tangent to rocket path. Discussion, by Derek F. Lawden, Jour. Brit. Interplanetary Soc., v.9, no.5, Sept.1950, p.230-234. Discussion of the controversy as to whether or not the tangential ellipse corresponds to the optimum method of transfer between circular orbits.

THE CALCULATION OF TAKE-OFF MASS. A. V. Cleaver. British Interplanetary Society Journal, v.9, no.1, Jan.1950, p.5-13. Also in Realities of Space Travel, ed. by L. J. Carter, p.54-65 (629.1388 C24). Brief discussion concerning take-off masses of rockets launched from the earth, as compared to the take-off masses of rockets launched from satellites.

1949

THE ESTABLISHMENT AND USE OF ARTIFICIAL SATELLITES. Eric Burgess, Aeronautics, v.21, no.4, Sept.1949, p.70-82. Studies of the means of attaining escape and orbital velocities.

1948

INITIAL ARC OF THE TRAJECTORY OF DEPARTURE. Derek F. Lawden. Journal of the British Interplanetary Society, v.7, 1948, p.119-123.

1947

LAGRANGE EQUATIONS FOR A SYSTEM OF VARIABLE MASS. Derek F. Lawden. Journal of the British Interplanetary Society, v.6, no.6, Sept.1947.

THE PROBLEM OF ESCAPE FROM THE EARTH BY ROCKET. F. J. Malina and Martin Summerfield. Journal of the Aeronautical Sciences, v.14, no.8, Aug. 1947, p.471-480. Discusses the performance of single and multistage rockets for escape from the earth's field and principles of optimization. Offers several possible designs. For discussion of above paper see: Dandridge M. Cole and L. I. Epstein: Interpretation of Malina-Summerfield Criterion for Optimization of Multistage Rockets. Jet Propulsion, v.26, no.3, Mar.1956, p.188.

ORBIT AND ORBITAL TRANSFER

1958

ESCAPE FROM A CIRCULAR ORBIT USING TANGENTIAL THRUST. D.J. Benney. Jet Propulsion, v.28, no.3, Mar.1958, p.167-169. Considers the problem of escape of a rocket from the gravitational field of a planet. Initially the space ship is taken to be in a circular orbit about the planet. The motors are then switched on and the thrust is taken as tangential to the direction of motion at each instant. Clearly the motion will remain in the plane of the circular orbit. It has been shown that a tangential thrust should be a close approximation to the optimal escape program.

INTERPLANETARY OPERATIONS. Krafft A. Ehricke. (Lecture for course - Space Technology). University of California - Lecture 4B. Feb.3-5,1958.

EFFECT OF AIR DRAG ON ELLIPTIC SATELLITE ORBITS. Robert E. Roberson. Jet Propulsion, v.28, no.2, Feb.1958, p.90-96. The eccentricity and characteristic radius of a close satellite orbit decrease with time because of atmospheric drag. Variation of parameters and the Krylov-Bogoliuboff approximation method are used to find simple approximate expressions for the decay of eccentricity with radius, the decay of radius with true anomaly and the growth of true anomaly with time. The special case of spiral orbits and the effect of asphericity and rotation of the earth's atmospheric shell are discussed.

LIFE-TIME OF AN ARTIFICIAL EARTH SATELLITE. D.C.M. Leslie. Nature, v.181, no.4606, Feb.8,1958, p.403-404.

EARTH SATELLITES AND RELATED ORBIT AND PERTURBATION THEORY. Samuel Herrick. (Lecture for course - Space Technology). University of California - Lecture 3A. Jan.27-29,1958.

MINIMUM TIME INTERPLANETARY ORBITS. Dandridge M. Cole, Martin Co. American Astronautical Society, Annual meeting, New York, Jan.29-31,1958. A brief review is presented of the work of Lawden and others on minimum-energy interplanetary orbits. The argument is presented that interest will be transferred from minimum-energy to minimum-time orbits when efficient nuclear propulsion systems become available.

INTERPLANETARY ORBITS. D.F. Lawden. (In Space Research and Exploration, edited by D.R. Bates). 1958. (629.1388 B31)

1957

ESTIMATING THE LIFE OF A SATELLITE. J.M.C. Scott - Cavendish Lab., Cambridge. Nature, v.180, no.4600, Dec. 28,1957, p.1467-1468.

ORBIT AND ORBITAL TRANSFER - Continued

LIFE-TIME OF AN ARTIFICIAL EARTH SATELLITE. J.A. Fejer. Nature, v.180, no.4599, Dec.21,1957, p.1413.

A NOTE ON SPACE TRAVEL IN A GRAVITATIONAL FIELD. E. Newton Rowland. Journal of the British Interplanetary Society, v.16, no.4, Oct.-Dec.1957, p.216-221.

THE PHYSICAL AND CHEMICAL FUNDAMENTALS OF SATELLITE FLIGHT. II - APPENDIX I,II,III - PERIOD OF REVOLUTION FOR A SATELLITE MOVING IN AN ELLIPTICAL ORBIT. Paul F. Winternitz. Journal of Astronautics, Autumn-Winter, 1957. p.65,68-70,80. Computation of the actual numerical values of the circular and escape velocities by replacing the simplifying assumption of constant gravitational force with Newton's law of gravitation, and analysis to determine the satellite's lifetime.

GLOSSARY OF ASTRONOMICAL TERMS FOR THE DESCRIPTION OF SATELLITE ORBITS. J. Ashbrook, G.F. Schilling, and T.E. Sterne. Smithsonian Institution Astrophysical Observatory, Special Report 4, Nov.30,1957. (CN-59408 Spec. Rept.4).

A METHOD OF INTEGRATING THE EQUATIONS OF MOTION OF A BODY ENTERING AN ARBITRARY ATMOSPHERE WITH AN AUTOMATIC ERROR ANALYSIS. Fausto G. Gravelos. (Paper given at the Eighth International Astronautical Congress, Barcelona, Oct.6-12,1957). American Rocket Society Preprint 507-57. The method of numerical integration is outlined and four examples of results obtained are given (the earth's atmosphere and three hypothetical planetary atmospheres).

GRAVITATIONAL AND RELATED CONSTANTS FOR ACCURATE SPACE NAVIGATION. Samuel Herrick, Robert M.L. Baker, Jr., and Charles G. Hilton. (Presented at 8th International Astronautical Congress, Barcelona, Spain, Oct.6-12,1957. Revision of Jan.1957 paper "Units and Constants for Geocentric Orbits"). American Rocket Society Preprint 497-57. (CN-57909)

DETERMINING THE LIFETIME OF AN ARTIFICIAL EARTH SATELLITE AND AN INVESTIGATION OF SECULAR PERTURBATIONS OF ITS ORBIT. D. Ye. Okhotsimskiy, T.M. Eneyev, and G.P. Taratynova. (Presented at Conference on Earth Satellites, Washington, D.C., Oct.2-5,1957 and at the 8th International Astronautical Congress). U.S. Joint Publications Research Service, Rept.187, p.46-68 (N-58836, pt.1). Translation from Uspekhi Fezicheskikh Nauk, v.63, no.1a, Sept.1957, p.33-50. Calculation of satellite life by the method of integral equation curves of first order in relation to one parameter. "Satellite timetable," a discussion of this paper appears in Engineering, v.184, no.4783, Nov.8,1957, p.582.

THE MOTION OF AN ARTIFICIAL SATELLITE IN THE NONCENTRAL GRAVITATIONAL FIELD OF THE EARTH IN THE PRESENCE OF ATMOSPHERIC RESISTANCE. G.P. Taratynova. (Presented at

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THE EFFECT OF GEOPHYSICAL FACTORS ON SATELLITE MOTION. I.M. Yatsunskiy. (Presented at Conference on Earth Satellites, Washington, D.C., Oct.2-5,1957). U.S. Joint Publications Research Service, Rept. 187, p.82-100 (N-58836, pt.1). Translation from Uspekhi Fizicheskikh Nauk, v.63, no.1a, Sept.1957, p.59-72. Effect of factors such as nonsphericity of the earth, anomaly of gravity and air resistance.

CERTAIN PROBLEMS ON THE DYNAMICS OF FLIGHT TO THE MOON. V.A. Yegorov. (Presented at Conference on Earth Satellites, Washington, D.C., Oct.2-5,1957 and at the 8th International Astronautical Congress). U.S. Joint Publications Research Service, Rept. 187, p.101-174 (N-58836, pt. 1). Translation from Uspekhi Fizicheskikh Nauk, v.63, no. 1a, Sept.1957, p.73-177. Data on work done in 1953-1955 concerning the following problems: shape and classification of trajectories; possible trajectories of moon circling with return to earth; possibilities of periodic circling of the moon and earth; the minimum initial speed needed to reach the moon evaluation of the different trajectories.

THE EFFECT OF THE EARTH'S OBLATENESS ON THE ORBIT OF A NEAR SATELLITE. D.G. King-Hele, and D.M.C. Gilmore. Royal Aircraft Establishment Tech. Note GW 475, Oct. 1957. The equations of motion of a satellite in an orbit over an oblate earth in vacuo are solved analytically by a perturbation method. The solution applies primarily to orbits for which the maximum and minimum altitudes of the satellite do not differ by more than 300 n. miles; the accuracy of the solution for radial distance should then be about 0.001%, and the error in angular travel about 0.001% per revolution. The four main effects of the earth's oblateness on the motion of the satellite are discussed. (N-58531)

ORBITAL BEHAVIOR OF EARTH SATELLITES. II - ORBITS ABOUT AN OBLATE SPHEROID. Robert E. Roberson. Franklin Inst., Journal, v.264, Oct.1957, p.269-285. Presentation of a method to (1) deduce the orbit geometry in the field of an oblate spheroid, as if no other external forces act; (2) calculate a rotating reference frame with respect to which the orbit is periodic; (3) relate the elements of the orbit to the kinematic and geometric initial conditions which exist when the orbit is established; and (4) develop the time behavior of the basic dependent variables which describe the orbit. The principal limitation of the analysis is its restriction to first order effects in the oblateness parameter.

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WILL SATELLITES BE SHORT-LIVED. R. Jastrow. Astronautics, Oct. 1957, p.31-52. Consideration of the electrostatic drag that may cause previous estimates of satellite lifetimes to be halved.

ORBITAL BEHAVIOR OF EARTH SATELLITES. I. Robert E. Roberson. Franklin Inst., Journal, Sept. 1957, p.181-202. Analysis on the effect of the oblateness of the earth on the orbits of close satellites. Includes a review of recent work in this field and a discussion of some of the perturbation sources on a satellite orbit. A solution of the first order in the oblateness is developed by a method similar to Hansen's classical perturbation method for orbits about an oblate spheroid. Particular attention is given to the effect of initial conditions on the orbit elements.

TRANSFER BETWEEN VEHICLES IN CIRCULAR ORBITS. Bernard H. Paiewonsky. Wright Air Development Center TN 57-267, Aug.1957. A simple method is developed for calculating the initial angular separation between two vehicles in circular orbits, required for the orbital transfer of a commuter rocket with a minimum expenditure of fuel. The time of flight in the orbit of transfer is used to compute the required vehicle relationships from their orbital angular velocities. The orbits of transfer between circular orbits are the Hohmann orbits (cotangential ellipses). A method is also presented for determining the relative angular positions of the satellites from in-flight measurements for the case of unobscured line of sight between satellites. (CN-55414)

SPIRAL AND ELLIPTICAL ORBITS. Brian Egerton. Royal Aeronautical Society, Journal, June 1957, p.422-423. Analysis of a possible flight path of a satellite.

EQUATIONS OF MOTION OF A MISSILE AND A SATELLITE FOR AN OBLATE-SPHEROIDAL ROTATING EARTH. B.E. Kalensher. Jet Propulsion Lab., Calif. Inst. of Tech. Memo.20-142, Apr.12,1957. Equations are derived by applying the fundamental definition of the derivative to Newton's second law of motion. Three independent cases are considered: motion of the missile center of mass, rotation of the missile about a transverse axis through the center of mass, and rotation of the missile about the longitudinal axis. (N-57858)

EFFECT OF EARTH'S OBLATENESS ON SATELLITE PERIOD. Leon Blitzer. Jet Propulsion, v.27, no.4, Apr. 1957, p.405-406,497. The effect of the earth's oblateness on the period of the latitudinal motion of a satellite in a near-circular orbit is investigated. It is shown that in addition to the usual dependence on altitude the period depends as well on the inclination of the orbit to the equator. For orbits in the neighborhood of the equator, the period is less than

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for an orbit at the same height around a spherical earth. The period increases with orbit inclination and for polar orbits the period is greater than for an orbit at the same height over a spherical earth.

FREE AND POWERED ORBITS IN CISLUNAR SPACE. Krafft A. Ehricke. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and Convair. In cislunar space there is a region where the perturbations by the earth have diminished considerably, but the lunar perturbations have not yet begun to increase severely as you begin to approach the moon. The main effect of these studies is to give one a good feel for the kind of operations that will be most effective in cislunar space.

ORBIT STUDIES USING HIGH SPEED DIGITAL COMPUTERS. Wilhelm Elfers. Astronautics symposium, held in San Diego, Feb.18-20, 1957, sponsored by Office of Scientific Res. and Convair. Orbit studies made at Martin Co., particularly in connection with the Vanguard project. Taken into account are: Take-off trajectory as well as the trajectory above the atmosphere, the aerodynamic forces using the wind in a three dimensional model.

LIFETIME OF ARTIFICIAL SATELLITES OF THE EARTH. Irvin G. Henry. Jet Propulsion, v.27, no.1, Jan. 1957, p.21. Aerojet-General Corp. Report. Calculation of the effect of density of the upper atmosphere on the lifetimes of earth satellites in elliptical and circular orbits. It is assumed that this density decays exponentially with altitude. Includes discussion of the physics of drag. (CN-54379)

ON THE APPLICATION OF THE METHOD OF VARIATION OF ELLIPTIC ORBIT ELEMENTS INCASE OF A SATELLITE VEHICLE. J.M.J. Kooy. Astronautica Acta, v.3, no.3, 1957, p.179-214. Outline of the determination of six elliptical orbit elements of the instantaneous Keppler motion of an artificial earth satellite and of the application of the method of variation of orbit elements, if the influences of the oblateness of the earth and the atmospheric drag, and solar and lunar disturbing forces are taken into account.

CISLUNAR OPERATIONS. Krafft A. Ehricke. American Rocket Society Preprint 467-57, 1957.

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THE ORBIT LIFETIMES OF THE U.S. ARTIFICIAL SATELLITES. Harold B. Ketchum. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.31-41. (N-58942) Journal of Space Flight, v.7, no.8, Oct.1955, p.1-5. Estimates of orbit lifetimes for satellites established at various initial average altitudes have been calculated, after development of a general method based upon theoretical considerations and using available extreme altitude data.

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DER RAUMSCHLITTEN. Georg Aumann. Zamm, (In German) Nov.-Dec.,1956. Deduction of the equations of motion for a force-free space sledge. A space sledge is defined as a rigid body moving in such a way that the absolute velocity of one of its points is either a) normal or b) parallel to a given direction within the body. It is shown that, in the case of spherical symmetry, there are - apart from the trivial periodic solutions - only solutions with periodic velocities in case a), while in case b) solutions with periodic velocities also exist.

PERTURBATIONS OF A SATELLITE'S ORBIT DUE TO THE EARTH'S OBLATENESS. Leon Blitzer, Morris Weisfeld, and Albert D. Wheelon. Journal of Applied Physics, Oct. 1956, p.1141-1149. Theoretical investigation, neglecting atmospheric deceleration, of the free-flight motion of a satellite around a spherical earth, and extension of the analysis to take into account the earth's oblateness, represented by an additional quadrupole field.

THE POTENTIAL ENERGY OF A SMALL RIGID BODY IN THE GRAVITATIONAL FIELD OF AN OBLATE SPHEROID. Robert E. Roberson, and D. Tatistcheff. Journal of the Franklin Institute, Sept.1956, p.209-214. Generalization of the extended McCullagh formula and application of the result to several special shapes of the subsidiary body, in order to provide the first step in the treatment of motions of such pairs of bodies in various special cases.

TRANSFER BETWEEN CIRCULAR ORBITS. Derek F. Lawden. Jet Propulsion, v.26, no.7, pt.1, July 1956, p.555-558. American Rocket Society Paper 265-55. A solution is given to the problem of transferring a rocket from a circular orbit about one planet into another about a second planet with minimum expenditure of fuel. The case of transfer between the general theory. (N-43522)

FACTORS AFFECTING LIFETIME OF EARTH SATELLITES. Norman V. Petersen. Aero Digest, v.73, no.1, July 1956, p.74-76,78,80,82. Orbital lifetimes for various proposed satellite designs calculated and plotted; duration of satellite's near circular motion around earth is indication of influence of atmospheric density existing at extreme altitudes.

MOTION OF A SMALL BODY IN EARTH-MOON SPACE. R.W. Buchheim. Rand Corp. RM-1726, June 4,1956. This memorandum sets forth analytical relations and numerical data that may be useful in studies of the trajectories of unpowered vehicles in the region of space dominated by the gravitational fields of the earth and the moon. (N-57705)

LIFETIMES OF SATELLITES IN NEAR-CIRCULAR AND ELLIPTIC ORBITS. Norman V. Petersen. Jet Propulsion, May 1956, p.341-351,368. Consideration of: (a) the general

characteristics of circular motion neglecting drag effects; (b) the structure of the atmosphere; (c) the free molecule flow drag, and (d) the equations of motions. An approximate solution to the non-linear differential equations of motion for near-circular constraint is derived.

THE EFFECT OF THE EARTH'S OBLATENESS AND ATMOSPHERE ON A SATELLITE ORBIT. John De Nike. Earth Satellites as Research Vehicles, Proceedings of the symposium held Apr.18,1956, Franklin Inst. Monograph 2. Journal of the British Interplanetary Society, v.16, no.1. Discussion of problems facing the Martin Co. in the designing and building of the rocket vehicle which is to launch the Vanguard satellite into orbit.

GRAPHICAL DETERMINATION OF BALLISTIC TRAJECTORIES THROUGH OUTER SPACE WITH COMPASS AND STRAIGHTEDGE. Richard H. Frick. Rand Corp. RM-1641, Feb.24,1956. This paper assumes a spherical, non-rotating earth with an inverse square law for gravitational attraction. Solutions are obtained for five different sets of boundary conditions, and the trajectory characteristics which are determined include projectile position, velocity, path angle, angular momentum, apogee position, and impact point. (CN-58135)

AN ARTIFICIAL SATELLITE FOR THE EARTH. V.R. Thiruvenkatachar. Journal Sci. and Ind. Res., Sect. A, Feb.1956, p.61-63. Discussion of such aspects of space problems as the height of the orbit, the period of revolution and the orbital velocity, and velocity and methods of launching.

THE ORBIT OF A SMALL EARTH SATELLITE. R.J. Davis, Fred Lawrence Whipple, and J.B. Zirker. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.1-22. (523.1 V26)

INTERPRETATIONS OF OBSERVED PERTURBATIONS ON A MINIMAL EARTH SATELLITE. Jackson L. Sedwick, Jr. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.44-48. (523.1 V26)

STUDIES OF A MINIMUM ORBITAL UNMANNED SATELLITE OF THE EARTH (MOUSE). PT.2 - ORBITS AND LIFETIMES OF MINIMUM SATELLITES. Siegfried Fred Singer. Astronautica Acta, v.2, no.3, 1956, p.125-144. Description of the elliptical orbit of an artificial satellite in terms of the launching condition, derivation of criteria for controlling these conditions, and analysis of the subsequent behavior of the orbit under the influence of the drag of upper atmosphere.

AN INTRODUCTION TO CELESTIAL MECHANICS. F.R. Moulton. New York, Macmillan Co., 1956. (521-M86)

ORBIT AND ORBITAL TRANSFER - Continued

PERTURBATION THEORY. Robert K. Mueller. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

MECHANICS OF ORBITS. Walter McKay. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

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POSSIBILITIES OF TRANSITION FROM AN ELLIPTICAL ORBIT TO A CIRCULAR ORBIT, AND VICE VERSA. Werner Schaub. (Translation from Weltraumfahrt, no.3-4,1952). Nov.15, 15,1955. Rand Corp. T-54. (CN-57926)

THE MOTION OF A SATELLITE STATION AROUND THE EARTH IN AN ELLIPTICAL ORBIT INCLINED TO THE EARTH'S EQUATOR. Helmut Krause. (Translation from Weltraumfahrt) Oct. 21,1955. Rand Corp. T-52. (CN-57268)

DYNAMIC PROBLEMS OF INTERPLANETARY FLIGHT. Derek F. Lawden. Aeronautical Quarterly, v.6, pt.3, Aug. 1955, p.165-180. Solution to problem of transferring rocket between two terminals in space with minimum fuel expenditure; results obtained when application is made to number of particular problems of space navigation; mathematical techniques which may usefully be employed in calculation of optimum rocket trajectories, exemplified by method of obtaining maximum range from rocket missile over earth's surface. Bibliography

STAY TIMES AND USES OF ORBITAL VEHICLES. N.V. Petersen, and Frederick I. Ordway, III. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

EQUATIONS OF MOTION OF SATELLITE IN UPPER REGION OF EARTH'S ATMOSPHERE. Charles A. Lundquist. Ordnance Missile Labs., Redstone Arsenal. Rept.6M64. Apr.1955. The equations of motion of a satellite under the influence of the gravitational field of the earth and a drag force due to air resistance are formulated. Effect of the rotation of the atmosphere is discussed. (N-53954)

ON THE PERIHELION MOTION ACCORDING TO LITTLEWOOD'S EQUATIONS. F.A.E. Pirani. Cambridge Philosophical Society, Proceedings, v.51, pt.3, 1955, p.535-537. (N-41245)

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PERTURBATION MANOEUVRES. Derek F. Lawden. Journal of the British Interplanetary Society, v.13, no.6, Nov.1954, p.329-334. Calculation of velocity increment induced in space ship due to its attraction by large moving body and with expenditure of fuel; such "perturbation maneuver" is seen as means of economizing in fuel requirement of interplanetary journey.

CORRECTION OF INTERPLANETARY ORBITS. Derek F. Lawden. Journal of British Interplanetary Society, v.13, no.4, July 1954, p. 215-223. If rocket fails to follow previously computed trajectory in space, it will become necessary to correct its erroneous orbit by small thrusts from motors; it is proved that, if instant at which correction is to be made has been chosen, appropriate velocity increment to be given to rocket is uniquely determined; scheme for assisting navigator by calculating numerical tables prior to rocket's departure.

EFFECT OF TIDAL FRICTION ON NEAR SATELLITE. J. Logie. British Interplanetary Society Journal, v.13, no.3, May 1954, p.170-175. Space station revolving round Earth below altitude of less than 100 miles would need powerful engines to sustain it, otherwise tidal friction will bring it down to Earth in few months.

ADVANCES OF THE PERIGEES OF EARTH-SATELLITES PREDICTED BY GENERAL RELATIVITY. Lincoln La Paz. Astronomical Society of the Pacific Publications, v.66, no.388, Feb. 1954, p.13-16. Mathematical investigation of the advances of lunar and satellite perigees moving about the earth.

ANALYSIS OF ORBITAL SYSTEMS. Krafft A. Ehricke. International Astronautical Congress, Proceedings, 1954, p.18-58. This paper presents an analysis of orbital systems, consisting of the orbital establishment, its supply vehicles and their technique of operation. Orbital supply systems are discussed, distinguishing between passenger-carrying and load-carrying orbital vehicles. (CN-54334)

ORBITS AND LIFETIMES OF MINIMUM SATELLITES. Siegfried Fred Singer. American Rocket Society Preprint 160-54. 1954.

KINEMATIC AND GEOMETRIC RELATIONS ASSOCIATED WITH MOTION OF A VEHICLE OVER THE EARTH. Ephraim Weiss. Instrumentation Lab., Massachusetts Inst. of Tech. R-68. 1954.

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MINIMAL ROCKET TRAJECTORIES. Derek F. Lawden. Jet Propulsion, v.23, no.6, Nov.-Dec.1953, p.360-367. The problem of the navigation of a rocket vehicle between two fixed terminals in space, in such a manner as to minimize the fuel expenditure, is analyzed in a general

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fashion, account being taken of a gravitational field, variable in space and time. The motion is assumed to take place in vacuo. The transit time may or may not be regarded as specified. The solution trajectory is shown to comprise a number of null-thrust arcs, separated by junctions at which impulsive thrusts are applied.

A GENERAL FORMULA FOR THE RELATION BETWEEN A FIELD OF FORCES AND THE ORBIT OF A BODY THEREIN. A. Lopez Cardoza. Fourth International Astronautical Congress, held in Zurich, Aug.3-8,1953. Plotting the orbit in a complex gravitational field is as important in space flight as calculating a course in ordinary flying. The relation between the field of force and the orbit of a body therein was expressed as a general formula in which time is eliminated and which can be solved in every case by means of an integrating machine. It is possible to derive forces necessary to make a space vehicle follow a prescribed path in a given field of forces.

THE DETERMINATION OF THE ORBIT FROM THE VECTOR OF THE VELOCITY AND THE INFLUENCE OF ITS VARIATION ON THE ORBITAL ELEMENTS. K. Schutte. Fourth International Astronautical Congress, held in Zurich, Aug.3-8,1953. Orbits are governed by the laws of celestial mechanics. The extent, shape and situation of the orbits are determined by the magnitude as well as by the direction of the velocity. Any variation in either, or of both, causes some variation in the orbit.

TAKE-OFF FROM SATELLITE ORBIT. H.S. Tsien. Journal of American Rocket Society, v.23, no.4, July-Aug.1953, p.233-236. American Rocket Society Preprint 93-53. For comments see: Krafft A. Ehricke "Take-off from satellite orbits", Jour. Amer. Rocket Soc., v.23, no.6, Nov.-Dec.,1953, p.372-374.

ESCAPE TO INFINITY FROM CIRCULAR ORBITS. Derek F. Lawden. Journal of the British Interplanetary Society, v.12, no.2, Mar.1953, p.68-71. The problem of escape from a circular orbit to infinity, the final velocity being specified, using a minimum of fuel, is considered.

TWO BALLISTICS PROBLEMS OF FUTURE TRANSPORTATION. William A. Allen. American Journal of Physics, v.21, no.2, Feb.1953, p.83-89. Solution of problem of vehicle moving along great circle of earth and of problem of rocket moving radially away from earth.

ON PLOTTING SMALL THRUST SPACE SHIP ORBITS. SPACE-FLIGHT PROBLEMS. J.M.J. Kooy. (Collection of lectures at the Fourth Astronautical Congress in Zurich, 1953). Cie-Biel-Bienne, Laubscher, 1953, p.108-111. Discusses the forces acting on space ships at the moment of arrival and departure from circular orbits.

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ORBITAL TRANSFER VIA TANGENTIAL ECLIPSES. Derek F. Lawden. Journal of the British Interplanetary Society, v.11, no.6, Nov.1952, p.278-289. Method of orbital transfer via eclipses and for calculating optimum transfer ellipse; special case of transfer between two orbits of small eccentricity considered.

INTER-ORBITAL TRANSFER OF A ROCKET. Derek F. Lawden. (English text and German summary). Proceedings of the Third International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.146-161. The problem of the transfer of a rocket between two coplanar elliptical orbits about the same centre of universe square law attraction along a trajectory requiring a minimum fuel expenditure is solved. (N-53323)

DETERMINATION OF THE TRAJECTORY OF A SLIGHTLY ACCELERATED ROCKET IN A CENTRAL GRAVITATION FIELD. (Die Bahnbestimmung einer Schwachbeschleuigten Rakete in einem zentralen Gravitationsfeld). H.F.Michielsen. (German text and English summary). Proceedings of the 3rd International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.174-180. Deals with motion of a body in a central field of force due to one rigid center of attraction, the body being subjected to a small rocket thrust. Perturbations due to other celestial bodies can be eliminated by a suitable additional small thrust equal and opposite to resultant disturbing force. The line of investigation, followed here, is one of "trial and error". (N-53323)

THE SECULAR DISTURBANCES OF A SPACE-STATION TRAJECTORY. (Die sakularstorungen einer Aussenstationsbahn). H.G.L. Krause. (German text and English summary). Proceedings of the 3rd International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.162-173. A method is developed to investigate secular perturbations for satellite orbits with any excentricity and inclination. Subject of the investigation is the motion of an artificial satellite at a mean distance of 1669 km from the surface of the earth making one revolution about the earth in 1 hour 59 min. 40.34 sec., inclination playing more essential role than excentricity. (N-53323)

GENERALIZED INTERPLANETARY ORBITS. H. Preston-Thomas. Journal of the British Interplanetary Society, v.11, no.2, Mar.1952, p.76-85. Paper by A.C. Clarke discussed some simpler properties of bodies moving in elliptic and hyperbolic orbits in solar system; present paper continues discussion to point where one can obtain to first approximation, time of flight and power requirements for journey between any two specified orbits.

OPTIMUM RANGE OF A WINGLESS ROCKET ABOUT A ROTATING EARTH. Gregg Mueller. California Inst. of Tech.,

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Thesis, 1952, 41p. The motion of a wingless rocket in a vacuum about a spherical non-rotating earth describes the elliptic orbit of a material point of mass in a central field of force... but when considering the effects of a rotating earth there is no simple mathematical solution. To analyze these effects it is necessary to solve the equations for various initial velocities at various angles of elevation and optimize the results by interpolation formulas.

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ORBITAL RENDEZVOUS PROBLEMS. Ralph Andrews Smith. Second International Congress on Astronautics, held in London by British Interplanetary Society, Sept.3-8,1951.

MOTION RELATIVE TO THE SURFACE OF THE ROTATING EARTH. R.H. Bacon. American Journal of Physics, v.19, Jan.1951, p.52-56.

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MINIMAL TRAJECTORIES. Derek F. Lawden. Journal of the British Interplanetary Society, v.9, no.4, July 1950, p.179-186. Mathematical statement about interplanetary journeys via arbitrarily selected orbits.

SPACE ROCKET TRAJECTORIES. Samuel Herrick. Journal of the British Interplanetary Society, v.9, 1950, p.234-241.

PERTURBATIONS OF A SATELLITE ORBIT. Lyman Spitzer, Jr. Journal of British Interplaetary Society, v.9, 1950, p.131-136.

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THE LAWS OF MOTION IN SPACE TRAVEL. Eugen Sänger. Interavia, v.4, no.7, July 1949, p.416-418. Mathematics of calculating the motion of an unpowered earth-satellite space ship at an altitude of 100 km.

DIE AUSSENSTATION. Heinz Gartmann. Die Weltluftfahrt, v.1, no.3, Mar. 1949, p.52-54. Study of velocities of satellites at different altitudes.

DYNAMICS OF SPACE-FLIGHT. Arthur Charles Clark. Journal of the British Interplanetary Society, v.8, no.2, Mar.1949, p.71-84. Subject divided into three sections: motion of body in earth's gravitational field, problem of lunar voyage, and true interplanetary journeys; no particular form of propulsion presupposed; table shows theoretical velocities needed for various typical journeys, and estimates of what these values may be in practice.

ON THE NECESSARY CONDITION FOR THE TRANSFORMATION INTO SATELLITES OF THE PLANET, OF BODIES PROJECTED FROM A PLANET. Caius Iacob. Gazeta Matematica (Bucharest), v.54, 1949, p.192-201.

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STATIONARY ORBITS. Arthur Charles Clarke. Journal of the British Astronomical Assn., v.57, no.6, Dec.1947, p.232-237. Discusses possibilities of discovering new orbits for subsatellites between the earth and moon.

BALLISTICS OF THE FUTURE, WITH SPECIAL REFERENCE TO THE DYNAMICAL AND PHYSICAL THEORY OF THE ROCKET WEAPONS. J.M.J. Kooy and J.W.H. Uytenbogaart. Technical Publishing Co., 1947, 472p. Chap. XII: Extraterrestrial dynamics of the rocket. Pages 408-409: Mathematical analysis of projectile orbits.

SUR LA RÉALISATION DE SATELLITES PERMANENTS DE LA TERRE AU MOYEN DE PROJECTILES TERRESTRES. Ernest Esclangon. Mémorial de l'Artillerie Francaise, v.21, no.4, 1947, p.1007-1019. Mathematical analysis of gravitational attraction on satellites.

GENERAL MOTION OF A ROCKET IN A GRAVITATIONAL FIELD. Derek F. Lawden. Journal of the British Interplanetary Society, v.6, 1947, p.187-191. (6510 JBIS/1947, v.6, no.7)

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THE MOTION OF A PARTICLE WITH NEGLIGIBLE MASS UNDER THE GRAVITATIONAL ATTRACTION OF A SPHEROID. Dirk Brouwer. Astronomical Journal, v.41, no.1156, p.223-231, 1946. (CN-54808)

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ON PERIODIC ORBITS IN THE RESTRICTED PROBLEM OF THREE BODIES. E.T. Whittaker. Monthly Notices of the Royal Astronomical Society, vol. LXII, no.5, Mar.14,1902, p.346.

THE COMPUTATION OF ORBITS. Paul Herget. Cincinnati U.

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ON PERIODIC ORBITS IN THE NEIGHBORHOOD OF CENTRES OF LIBRATION. H.C. Plummer. Monthly Notices of the Royal Astronomical Society, vol.LXII, no.1, Nov.8,1901, p.6.

ON CERTAIN DISCONTINUITIES CONNECTED WITH PERIODIC ORBITS. S.S. Hough. Acta Mathematica, vol.24, 1901, p.247.

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DYNAMICS - ATTITUDE, STABILITY, GUIDANCE CONTROL AND NAVIGATION

1958

TORQUES ON A SATELLITE VEHICLE FROM INTERNAL MOVING PARTS. Robert E. Roberson. (1957 annual meeting, ASME Trans.57-A-39). Mechanical Engineering, v.80, no.3, Mar.1958, p.119 (To be published in Jour. of Applied Mechanics; available to Oct.1,1958). This paper derives a complete expression for the attitude perturbation torque from this source, interpreting each of its terms. The attitude reference co-ordinate system is discussed. The nature of the torque is found for three simple cases.

A SIMPLE PASSIVE METHOD FOR PREDICTING THE PATH OF A SPACE SHIP WITH RESPECT TO A PLANET WHICH IT IS APPROACHING. George Xenakis. Wright Air Development Center TN 58-42, Feb.1958. A simple method is presented for determining the velocity vector and predicting the flight path of a space ship with respect to a planet which it is approaching. The method is completely passive and requires only knowledge of the planet's radius and mass, a stellar fixed inertial reference system within the space ship, and suitable instrumentation for measuring angles and angular rates. (CN-58850)

ANALYSIS OF AN INERTIAL GUIDANCE SYSTEM. D.B. Duncan. Jet Propulsion, v.28, no.2, Feb.1958, p.111-116. The characteristics of an inertial navigation system for a simplified guidance problem are described. Error equations relating component performance to guidance accuracy are derived. These equations exhibit the 84 min. period oscillations which typify inertial systems.

DETERMINATION OF A UNIQUE ATTITUDE FOR AN EARTH SATELLITE. William R. Davis. American Astronautical Society, Annual meeting, held in New York, Jan.29-31,1958. Depends only upon (1) requirement that the three principal moments of inertia of the body be different, (2) the diverging nature of the gravitation field, and (3) the centrifugal-force effects of the orbital angular velocity. Both mathematical and physical models are discussed. Particular emphasis is given to the existence of unique attitude about a body axis which is maintained always collinear with the radius vector from the center of the gravitational field to the center of mass of the body.

FUNDAMENTALS OF INERTIAL GUIDANCE AND NAVIGATION. William E. Frye. Americal Astronautical Society, Annual meeting, held in New York, Jan.29-31,1958. Some of the basic concepts of the science of inertial navigation and guidance, including possible applications to space flight and astronautics are discussed. The principal of the Schuler pendulum and the fundamentals of accelerometers are described.

DYNAMICS - ATTITUDE, STABILITY, GUIDANCE CONTROL AND NAVIGATION - Continued

INERTIAL AIDS FOR SPACE TRAVEL. Charles J. Mundo. American Astronautical Society, Annual meeting, held in New York, Jan. 29-31,1958. Deals with: (1) Inertial navigation is a means of determining a vehicle's position by double integration of vehicle acceleration. (2) Accelerations due to nongravitational forces are determined by direct measurement using accelerometers. (3) It is impossible to determine accelerations due to gravitational forces by direct accelerometer readings. Therefore, gravitational accelerations must be determined by computations based on "a prior" knowledge of gravitational field pattern together with vehicle's computed position. This computation gives rise to a feedback loop in the inertial navigation system which has the capability of sustained oscillations. (4) In order to maintain the accelerometer sensitive axes aligned, with the proper coordinate system it is necessary to mount components on a stabilized inertial platform which obtains directional reference in inertial space from gyroscopes.

INERTIAL NAVIGATION AND SPACE FLIGHT. T.V. Newman. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31, 1958. Recent activity in the field of guided missile development has underlined the importance of automatic navigation systems. In addition, anticipated increases in the speed of manned aircraft indicate the desirability of automatic navigation techniques for this application as well. This paper is concerned with some special considerations concerning the application of the basic principles of inertial navigation to space travel.

MEASUREMENT OF VELOCITY IN SPACE. David Sonnabend. American Astronautical Society, Annual meeting, held in New York, Jan.29-31,1958. An instrument has been devised for measuring the instantaneous inertial velocity in space based upon Bradley's stellar aberrations. The theory is developed and the proposed instrument founded on this theory is described. The techniques used will be integrated into a complete celestial navigation scheme.

INTERPLANETARY APPLICATIONS OF AUTOMATIC NAVIGATION. Edward V. Stearns. Americal Astronautical Society, Annual meeting, New York, Jan.29-31,1958. Among navigation systems are (1) a combination of successive position fixing and dead reckoning, (2) a system based on ground speed using a reference heading and maintaining surveillance on track or present position, and (3) systems based on the mechanization of the celestial navigation problem. Techniques are described for interplanetary travel.

DYNAMICS - ATTITUDE, STABILITY, GUIDANCE CONTROL AND NAVIGATION - Continued

GRAVITATIONAL TORQUE ON A SATELLITE VEHICLE. Robert E. Roberson. Journal of the Franklin Institute, v.265, no. 1, Jan.1958, p.13-22. Determination of the gravitational torque components along the principal axes of inertia for a satellite vehicle in the field of the earth, using a potential function for a small rigid body in the field of an oblate spheriod developed previously by Roberson and Tatistcheff. The defining relationships are not completely reduced for large angular motions of the satellite, but torque components are found explicitly in terms of the angle of attitude deviation from a desired attitude reference for the small-angle case.

DIFFICULTIES OF SPACE NAVIGATION. J.G. Porter. (In Space Research and Exploration, edited by D.R. Bates). 1958. (629.1388 B31)

1957

THE DAMPING OF METALLIC CYLINDRICAL AND SPHERICAL BODIES ROTATING IN A UNIFORM MAGNETIC FIELD. John W. Hooper. Army Ballistic Missile Agency. DG-R-15, Nov.1,1957. The magnetic damping of the motion of metallic bodies rotating in a magnetic field is studied particularly as applicable to the operation of an earth satellite. Generalized cylindrical and spherical bodies are considered both analytically and from a model theory standpoint. The general solution for the field distribution within the rotating bodies, as derived from Maxwell's equations, is discussed. This paper investigates the nature and the magnitude of the damping factor produced by the vertical component of the earth's magnetic field. Generalized cylindrical and spherical bodies are considered. (N-56756)

ATTITUDE CONTROL OF A SATELLITE VEHICLE: AN OUTLINE OF THE PROBLEMS. Robert E. Roberson. Paper given at 8th International Astronautical Congress, Barcelona, Oct. 6-12,1957. Design problems of an attitude control system include the choice of an attitude reference system and of reference axes within the body, and the nature of the attitude perturbation torques acting on the satellite (the earth's gravitational, magnetic and electric fields, the sun's radiation pressure, the pressure of electromagnetic radiation from the satellite, air drag, meteoric bombardment, cosmic ray bombardment, gravitational fields of celestial bodies, nonuniform rotation of reference coordinates, and moving parts within the satellite. Attitude equations of motion are derived and requirements for a control system suggested.

SELENOID SATELLITES. W.B. Klemperer and E.T. Benedikt.

DYNAMICS - ATTITUDE, STABILITY, GUIDANCE CONTROL AND NAVIGATION - Continued

Paper given at the Eight International Astronautical Congress, Barcelona, Oct.6-12,1957. American Rocket Society. Paper 486-57. Concerns the conditions for the establishment of a selenoid (artificial satellite of the Moon) in such as orbit that it remains in a constant aspect relationship with Earth and Moon. This is a special case of the three-body problem and was first solved by Lagrange in 1772. (CN-57886)

THE FREE VIBRATION OF A VARIABLE MASS. C. Charles Miesse. Jet Propulsion, v.27, Oct.1957, p.1103. For comments see: A remark on the free vibration of a variable mass, by George Leitmann, and On the free vibration of a variable mass, by J.J. Marcinek. Jet Propulsion, v.28, no.3, Mar.1958, p.197-199.

VANGUARD CONTROL SYSTEM. L. Arnowitz. Astronautics, v.2, no.3, Oct.1957, p.34-36, 84-85. Control system for putting satellite into its chosen orbit first and second stage powered flight; no control system in third stage; reference gyro is heart of control system.

SOME PROBLEMS OF INSTRUMENTATION, TELEMETRY AND GUIDANCE. A.W. Lines. (Paper given at the Cranfield Symposium, July 18-20,1957). Spaceflight, v.1, no.5, Oct.1957, p.175 (summary of paper). Significant improvements have been made in the operating ranges and ability to withstand vibration of some standard high altitude instrumentation. The telemetry system for the Skylark uses the well-known equipment operating at a frequency of 465 megacycles/sec., with frequency modulation. The problem of accurate placing of a satellite vehicle into a desired orbit is one of great difficulty. On the grounds of economy in payload, consideration is given to a radar-radio guidance system.

ELEMENTS OF INERTIAL NAVIGATION. William T. Russell. (Presented at ARS semiannual meeting, San Francisco, Calif., June 10-13,1957). American Rocket Society Preprint 431-57. (CN-54565)

SPIN-STABILIZED UNSYMMETRICAL BODIES. E.V. Laitone. Jet Propulsion, v.27, no.4, Apr.1957, p.417.

ACCURATE NAVIGATION OF INTERCONTINENTAL AND SATELLITE VEHICLES IN THE EARTH'S GRAVITATIONAL FIELD. Samuel Herrick. Astronautics symposium, held in San Diego, Feb. 18-20,1957, sponsored by Office of Scientific Res. and Convair. Emphasizes the need for accurate values of a primary gravitational constant, k^2, and of the coefficients J and K of the second and fourth harmonies in the earth's potential.

A SATELLITE ATTITUDE CONTROL SYSTEM. Hermann J. Oberth. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and

DYNAMICS - ATTITUDE, STABILITY, GUIDANCE CONTROL AND NAVIGATION - Continued

Convair. A device is described in which a pendulum would be mounted off-center in a vehicle; this pendulum would be used as an attitude indicator. Equations are given for the stresses and the tidal forces which would be acting on some point on the rotating vehicle.

ON THE ACCURACY REQUIREMENTS FOR TRAJECTORIES IN THE FIELD OF THE EARTH AND THE MOON. Hans A. Lieske. Astronautics symposium, held in San Diego, Feb.18-20, 1957, sponsored by Office of Scientific Res. and Convair. Emphasizes the high accuracy requirements of the velocity vector of an object which is leaving the earth on a ballistic trajectory, depending upon the objectives.

(CONCERNS A SYSTEM IN WHICH AN UNMANNED VEHICLE IS NAVIGATED FROM A CIRCULAR ORBIT CENTERED AROUND MARS.) H.E. Singleton. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Process would require 1 year. Region of interest is transition orbit. Navigation is automatic.

ACCURACY REQUIREMENTS FOR TRAJECTORIES IN THE EARTH-MOON SYSTEM. Hans A. Lieske. (Presented at Astronautics Symposium, San Diego, Feb.1957). Rand Corp. P-1022. Discussion is restricted to two types of unmanned vehicles. The first and simple is the ballistic rocket. Its trajectory is determined by the initial conditions, i.e., the vehicle's position and velocity vector. The second more sophisticated type can be assumed to be capable of making velocity changes either to correct or to alter its trajectory. (CN-58140)

INERTIAL GUIDANCE. Walter Wrigley, Roger B. Woodbury, and John Hovorka. (Presented IAS, Jan.31, 1957). Institute of the Aeronautical Sciences. Preprint 698.

ON DETERMINING THE ORIENTATION OF A CYLINDRICAL ARTIFICIAL EARTH-SATELLITE. R.J. Davis, R.C. Wells, and Fred L. Whipple. Astronautica Acta, v.3, no.4, 1957, p.231-236.

THE EFFECT OF THE EARTH'S MAGNETIC FIELD ON THE SPIN OF THE SATELLITE. Herbert B. Rosenstock. Astronautica Acta, v.3, no.3, 1957, p.215-221. The angular velocity ω as a function of time t to a sphere or spherical shell rotating about an axis perpendicular to a uniform magnetic field β is given by $\omega(t) = \omega(0)\exp(-t/\tau)$, where the time constant τ, besides depending on the nature of the material, is inversely proportional to β^2. Application of these results to the proposed satellite moving in the geomagnetic field. τ is found to be of the order of ten days.

SATELLITE LIBRATIONS. W.B. Klempere and R.M. Baker, Jr. Astronautica Acta, v.3, no.1, 1957,

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p.16-27. Calculation of oscillations of a satellite about the equilibrium attitude from the shape and orbital period.

MECHANICAL ASPECTS OF THE VANGUARD FLIGHT CONTROL SYSTEM. F. Gordon Sholes. American Rocket Society. Preprint 424-57. 1957. (CN-54954)

UBER DIE VERWENDUNG VON PHOTOELEMENTEN IN KUNSTLICHEN ERDSATELLITEN. (German). Wilfried Berger. Raketentech and Raumfahrtforsch., No.1, 1957, p.22-23. Investigation of the application of photoelements in artificial earth satellites and analysis of the problems which arise therefrom.

1956

NAVIGATION IN INTERPLANETARY SPACE. Peter Castruccio. Missiles & Rockets, Dec.1956, p.98-99, 101. Discussion of three systems of space navigation: (1) beams aimed between planets, forming polygons of variable legs, each of which always represents the shortest distance between planets; (2) very broad beams, or omnidirectional radiators, placed on the planet of destination; and (3) space Loran or an analogous system.

THIS IS INERTIAL NAVIGATION. Walter Wrigley and John Hovorka. Research and Engineering, Dec. 1956.

ORIENTATION IN SPACE. M. Vertregt. Journal of the British Interplanetary Society, v.15, no.6, Nov.-Dec.1956, p.324-38. System of coordinates is established using plane of Earth's orbit as plane of reference, with sun in center; position of spaceship is determined by its helicocentric longitude and latitude according to frame of reference, and its distance from sun; determination of shape and position of orbit.

NAVIGATION BY SATELLITES. Lowell Lawrence, Jr. Missiles and Rockets, Oct.1956, pp.48-52. Discussion covering the problems involved in designing the Artificial Satellite Time and Radio Orbit (ASTRO) celestial navigation system, possible satellite designs, description of ASTRO's method of operation, and the Doppler Shift.

ON THE DIGITAL COMPUTER SOLUTION OF THE EQUATIONS OF MOTION FOR A NON-MIRROR SYMMETRICAL PROJECTILE WITH FOUR-FOLD ROTATIONAL SYMMETRY. Robert J. Stirton. Naval Ordnance Test Station NAVORD Rept. 5336, Sept.27,1956. A numerical method of solution of a set of ordinary differential equations and an outline of the encoding for the IBM 701 calculator are given. The differential equations describe the motion of a non-mirror symmetrical rocket with fourfold rotational symmetry. Aerodynamic forces and moments with nonlinear yaw dependence and with roll-orientation dependence were included. (CN-51103)

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ADVISORY GROUP FOR AERONAUTICAL RESEARCH AND DEVELOPMENT, SECOND GUIDED MISSILES SEMINAR GUIDANCE AND CONTROL. (Held in Venice, Italy, Sept.24-28,1956). AGARDograph 21. (N-58856)

LUNAR INSTRUMENT CARRIER - ATTITUDE STABILIZATION. R.W. Buchheim. Rand Corp. RM-1730, June 4,1956. In this report the various attitude disturbances acting on a moon rocket are considered and their magnitudes are estimated. It is shown that the attitude-stabilization requirements can be satisfied by spinning the vehicle at about 80 rpm around its roll axis. Effects of vehicle shape and mass distribution on the attitude problem are examined, and design restrictions are indicated. (CN-57704)

SOME APPLICATIONS OF AUTOMATIC NAVIGATION. Edward V. Stearns. Journal Inst. Navigation, June 1956, pp.66-72. Discussion of the techniques of an automatic navigation system and its application to interplanetary navigation.

SATELLITE ASCENT MECHANICS. Jorgen Jensen. Jet Proplusion, v.26, no.5, pt.1, May 1956, p.341-83. Analysis of guidance accuracy requirements for the injection elevation angle and velocity.

CONTROL AND POWER SUPPLY PROBLEMS OF INSTRUMENTED SATELLITES. Ernst Stuhlinger. Jet Propulsion, May 1956, pp.364-368. Description of a method of using the earth's shadowing effect on the isotropic cosmic radiation to regulate the satellite's attitude in relation to the earth's center, and of several possible systems having a specific power production of 0.4 and 0.7 watts per pound of weight to produce about 100 watts of electric power each.

"ASTRO" - AN ARTIFICIAL CELESTIAL NAVIGATION SYSTEM. Lowell Lawrence, Jr. Earth satellites as research vehicles, proceedings of the symposium held Apr.18,1956, Franklin Institute, Monograph 2. Discusses the peaceful use of Astro, an "Artificial Satellite Time and Radio Orbit" to be established over the earth for celestial navigation purposes.

SATELLITE ASCENT GUIDANCE REQUIREMENTS. Jorgen Jensen. Journal of Astronautics, v.3, no.1, Spring 1956, p.1-3, 14. Americal Rocket Society, Preprint 282-55. Guidance requirements in launching close orbit satellite about earth; effects on orbit due to errors in injection condition, namely, cut-off, velocity increment above or below circular orbit velocity, and that due to elevation angular errors.

DYNAMIC CONSIDERATIONS RELATING TO THE BEHAVIOR OF INERTIAL SPACE-STABILIZED PLATFORMS. Edmund Gorczycki. Journal of the Aeronautical Sciences, Feb.1957, p.130-38. (IAS 24th Annual Meeting, New York, Jan.23-26,1956. Preprint 608).

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ULTRAVIOLET STELLAR MAGNITUDES. Robert J. Davis. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific uses of earth satellites, ed. by James A. Van Allen, 1956, p.157-165. (523.1 V26)

GUIDANCE AND CONTROL (OF A SATELLITE). Walter Wrigley. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

1955

ARTIFICIAL SATELLITE ORBIT SYNCHRONISING SYSTEM. A. Boni. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

SOME PROBLEMS IN SPACE TRAVEL. J.G. Porter. J. Inst. Navigation, v.8, no.3, July 1955, p.224-230; discussion, p.230-235. Orbital techniques of rockets and space stations involved in a trip to the moon and other planets.

SYMPOSIUM: SOME PROBLEMS ASSOCIATED WITH TELEMETERING AND REMOTE CONTROL OF A SPACE STATION. Institute of Radio Engineers, IRE Convention Record, Part 10 - Instrumentation, telemetry, and nuclear science. (Contains papers presented at IRE convention, New York, Mar.21-24,1955. Session 6: Telemetry and Remote Control I.) (N-39571)

NUCLEAR MAGNETISM AS SPACE REFERENCE. Murray J. Neufeld. (Thesis submitted for degree of Master of Science). Instrumentation Lab., Mass. Inst. of Tech. T-82, 1955. The object of this thesis is to investigate the magnetic moment of a nucleus and its subsequent motion and orientation in the presence of magnetic fields and to determine as far as possible whether the principles involved may lead to a feasible solution to the problem of acquiring a reliable reference in inertial space. (CN-48289)

RADIO CONTROLLED ROCKETS. I. Kucherov. Rand Corp. RM-1922, p.31-43 (CN-47550, pt.2). Directorate of Scientific Intelligence, Translation 13 (Canada). Translation from Radio, no.8, 1955, p.50-53 (CN-52200). This report is concerned with the radio control of rockets capable of reaching the moon.

SUN-FOLLOWER FOR HIGH ALTITUDE SOUNDING ROCKET. D.D. Terwilliger and G.J. Granros. Americal Rocket Society. Preprint 266-55, 1955. (CN-43521)

GUIDANCE. Arthur Locke. (Vol. 1 of "Principles of guided missile

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design", edited by Grayson Merrill). Van Nostrand, 1955. Offers a comprehensive presentation of the many problems connected with inertial guidance applicable to satellite systems. (623.451 L79)

1954

DEVELOPMENT OF A STABILIZATION SYSTEM FOR THE VIKING ROCKET. N.E. Felt, Jr. (Presented at 9th annual meeting, ARS, New York, Nov.30-Dec.3,1954). American Rocket Society, Inc., Preprint 171-54. (CN-59396)

INSTRUMENTATION FOR SPACE VEHICLES. George W. Hoover. Presented at 9th annual meeting of the American Rocket Society, New York, Nov.30-Dec.3,1954, 3p. American Rocket Society Paper 157-54. Instrumentation for space vehicles can be divided into two categories: research instrumentation, or the measurement of scientific phenomena; and instrumentation for control and orientation of a manned vehicle. Discussion of quantities to be measured and units of measurement.

ON AUTOMATIC INTERNAL AND EXTERNAL CONTROL OF LONG RANGE ROCKETS. J.M.J. Kooy. Fifth International Astronautical Congress, Innsbruck. Aug.5-7,1954, p.168-177. Rocket is steered by an automatic pilot mounted in vehicle. If automatic pilot operates correctly, the rocket described its orbit without external intervention. Rocket is supervised by a terrestrial station which by radio signals automatically interferes as soon as the rocket deviates from prescribed orbit.

NAVIGATION WITHOUT GRAVITY. J.G. Porter. Journal of the British Interplanetary Society, v.13, no.2, Mar.1954, p.68-74. Small errors in initial speed and direction of spaceship discussed in relation to large errors which these cause in size and shape of orbit; some form of navigation is essential in space travel, and some simple methods are suggested; difficulties of correcting course.

FUNDAMENTALS OF SPACE NAVIGATION. Derek F. Lawden. Journal of the British Interplanetary Society, v.13, no.2, Mar.1954, p.87.

1953

THE APPLICATION OF RADIO INTERFEROMETRY TO THE INTERPLANETARY GUIDANCE OF ROCKET SHIPS. Marcel J.E. Golay. 4th International Astronautical Congress, Zurich, Aug.3-8,1953. American Rocket Society. Preprint 95-53. The accuracy of velocity determination of an interplanetary rocket at launching was shown to be no greater than the accuracy of our present knowledge of planetary distances, which is of the order of one part in 104. The essential element of a guidance system will be a radio interferometric "yardstick" which will be required to

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operate within radio band-widths of less than 1 cps.

EARTH SCANNING TECHNIQUES FOR ORBITAL ROCKET VEHICLES. Kurt R. Stehling. 4th International Astronautical Congress, held in Zurich, Aug.3-8,1953. American Rocket Society. Preprint 86-53. Two possible methods of viewing the earth's surface from a satellite vehicle were considered assuming a restricted payload and instrument bay of a minimum satellite vehicle. First was an optical objective lens image-converter system and second was a microwave radar scanner.

NAVIGATIONAL CALCULATIONS IN SPACE FLIGHT (INVESTIGATION OF THE EFFECT OF THE PRECISION OF ASTRONOMICAL DATA). Part I: Planetary orbital distances. Part II: Planetary orbital velocities and gravitational fields; and the gravitational field of the sun. Part III: Satellite gravitational fields, orbital velocities and elements of orbits. Part IV: The aspects of atmospheric friction (the earth's atmosphere). Harold B. Ketchum. Journal of Space Flight, v.5, no.4, Apr. 1953, p.1-8 (I), Journal of Space Flight, v.5, no.7, Sept. 1953, p.1-5 (II), Journal of Space Flight, v.5, no.10, Dec. 1953, p.1-9 (III), Journal of Space Flight, v.6, no.6, June 1954, p.1-8 (IV).

EARTH SCANNING TECHNIQUES FOR A SMALL ORBITAL ROCKET VEHICLE. Kurt R. Stehling, James Forrestal Research Center, Princeton U. Amer. Rocket Soc., Preprint 97-53. 1953.

1952

AUTOMATIC NAVIGATION OF A LONG RANGE ROCKET VEHICLE. T.C. Adamson and E.L. Knuth. Journal of the American Rocket Society, v.22, no.4, July-Aug.1952, p.192.

INTERPLANETARY COMMUNICATIONS AND NAVIGATION. J.P. Elliot. Journal of Space Flight, v.4, no.5, May 1952, p.1-6.

1951

THE ANGULAR MOTION OF HIGH-ALTITUDE ROCKETS. James Alfred Van Allen. Preceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9,1951. University of New Mexico Press, 1952, p.412-431. (629.13256 P56)

SOME PROBLEMS OF INTERPLANETARY NAVIGATION. D.J. Cashmore. Journal of the British Interplanetary Society, v.10, no.2, Mar.1951.

1950

LUNAR PARALLAX METHOD OF ASTRO NAVIGATION. J.S. Thompson. Rand Corp. P-181, Dec.12,1950. In considering the problem of the automatic navigation of long-range

surface-to-surface missiles it soon becomes evident that the system must be "unjammable" by the enemy. One interesting system not subject to such maltreatment would measure the change in the position of the moon relative to the stars due to the motion of the observer (the missile, in this instance) over the surface of the earth. The elements of the system are described. (N-57818)

1949

THE SPECIAL THEORY OF RELATIVITY AND SPACE SHIP NAVIGATION. John Spaulding. Chicago Rocket Society, Collection Tech. Repts., v.3, 1951, p.16. Journal of Space Flight, v.1, no.3, Aug. 1949.

1948

THE SPEED OF LIGHT AND SPACE SHIP NAVIGATION. Wayne Proell. Chicago Rocket Society, Collection Tech. Rept., v.2, 1951, p.25. The Rocket News Letter, v.2, no.4, Nov.1948.

THE VISIBILITY OF STARS IN THE DAYLIGHT SKY. R. Tousey and E.O. Hulburt. Journal of the Optical Society of America, v.38, no.10, Oct.1948, p.886-896.

LOSS OF SPIN OF PROJECTILES. PART I - EXPERIMENTAL METHOD. James Alfred Van Allen. Journal of the Aeronautical Sciences, v.15, no.1, Jan.1948, p.35-38. (N-7004)

1945

THE PROBABILITY DISTRIBUTION AROUND A FIX IN CELESTIAL NAVIGATION. Armin J. Deutsch. American Journal of Physics, v.13, no.6, Dec.1945, p.379-383.

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DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.)

1958

RECOVERY DYNAMICS - POSSIBILITY OF NON-DESTRUCTIVE LANDING. Alfred J. Eggers, Jr. (Lecture for course Space Technology). University of California - Lecture 6B, Feb.24-26,1958.

ON THE VALIDITY OF CONTINUUM THEORY FOR SATELLITE AND HYPERSONIC FLIGHT PROBLEMS AT HIGH ALTITUDES. Mac C. Adams and Ronald F. Probstein. Jet Propulsion, v.28, no.2, Feb.1958, p.86-89. Order of magnitude estimates are made to establish the flight conditions for which a continuum analysis should be applicable in the stagnation region of a blunt body. The results are applied to the problem of re-entry of a satellite and it is concluded that a continuum analysis, with no slip at the body surface, is valid for the flight conditions where heating is important.

SUPERSONIC FLOW ABOUT BLUNT BODIES OF REVOLUTION. Fausto G. Gravelos. American Astronautical Society, Annual Meeting, New York, Jan.29-31,1958. A method is developed for the computation of the pressure at and of the density field around a blunt body of revolution moving at supersonic speeds.

THE DYNAMICS AND CERTAIN ASPECTS OF CONTROL OF A BODY RE-ENTERING THE ATMOSPHERE AT HIGH SPEED. Joseph D. Welch and S. L. Shih. (Presented at 26th annual meeting, IAS, Jan.27-30,1958). Institute of the Aeronautical Sciences. Preprint 818. (CN-58733)

RADIOACTIVE RECOVERY TECHNIQUE FOR MISSILE AND AIRCRAFT. Frank Pollard. Spaceflight, v.1, no.6, Jan.1958, p.220-221.

1957

HYPERSONIC FLIGHT AND THE RE-ENTRY PROBLEM. Harry Julian Allen. (21st Wright Brothers Lecture). NACA. Dec.17,1957. It is a purpose of this paper to compare optimum performance of three rocket vehicles (ballistic-, the glide-, and the skip-rocket) with one another and also to compare them with a typical supersonic airplane powered by air breathing engines. Such questions as the following are discussed: Can rocket vehicles compete with supersonic airplanes on an efficiency basis for long range flight? What types of rocket vehicles, if any, appear attractive and under what circumstances? What new problems occur with these vehicles and do they appear surmountable? (N-57588)

THE USE OF LIFT FOR RE-ENTRY FROM SATELLITE TRAJECTORIES. Antonio Ferri, Lewis Feldman, and W. Daskin. Jet Propulsion, v.27, no.11, Nov.1957, p.1184-1190. The combined use of lift and heat sinks in the reentry problem is studied in this paper. Three types of trajectory were investigated. The results of the analysis show that

DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.) - Continued

the combination of reasonable amounts of lift and heat capacity, with properly chosen trajectories, can greatly alleviate the aerodynamic heating problem.

FEASIBILITY OF THE PHYSICAL RECOVERY OF SCIENTIFIC-RESEARCH PAYLOADS FROM VERY-HIGH-ALTITUDE NEAR-VERTICAL TRAJECTORIES. R. T. Patterson. (Paper given at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957). American Rocket Society Preprint 489-57. Useful payloads of 25 to 200 lbs. in spherically-nosed bodies between 1 and 2 feet in diameter falling vertically from altitudes of 2,000 miles and higher are considered. Entrance velocities range upward from 21,000 feet per sec. and useful payload must withstand deceleration of at least 109g. The total heat input to the body ranges upward from 4,000 BTU and is accomodated by permitting a part of the payload to melt. (CN-58810)

RECOVERY OF A CIRCUM-LUNAR INSTRUMENT CARRIER. Carl Gazley, Jr. and David J. Masson. (Presented at 8th International Astronautical Congress, Barcelona, Spain, Oct.6-12,1957). American Rocket Society, Inc. 488-57. Possibility of the physical recovery of a circum-lunar vehicle widens the scope of scientific investigations possible for a vehicle with lunar capabilities. While a very high guidance capability is necessary to impact such a recoverable vehicle within a given area on the earths surface, only moderate accuracy is required to effect just a return to earth. Radio tracking during return would enable prediction of the approximate impact point. (CN-57893)

RECOVERY TECHNIQUES FOR MANNED EARTH SATELLITES. Norman V. Petersen. Paper given at the Eighth International Astronautical Congress, Barcelona, Oct.6-12,1957. Recovery of artificial satellites presents a more difficult problem than launching and orbiting; possible techniques include rocket braking, aerodynamic braking, and retrieval with high-speed aircraft. Emphasis is laid on this last method. Current research on high-speed vehicles and zero-gravity flights is reviewed and suggestions are made concerning the characteristics of a satellite-retrieving aircraft system. The programming of the two flight paths to coincidence will necessarily require a complex homing guidance control system.

EXIT AND RE-ENTRY PROBLEMS. G. V. Bull, K. R. Enkenhus, and G. H. Tidy. (Presented at CAI-IAS joint meeting, Oct.21-22,1957). Institute of the Aeronautical Sciences, Preprint 759. These problems arise from the nature of the distribution of velocity and acceleration along ballistic trajectories in an atmospheric medium and generally are not well understood in detail. In many

DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.) - Continued

instances, their importance can be estimated only by an order of magnitude analysis: in such a way many gross effects can be shown to be of second order importance in so far as the aerodynamics of the present-day rocket is concerned. (CN-56474)

AERODYNAMIC ABLATION OF MELTING BODIES. Theodore R. Goodman. Wright Air Development Center TR 57-284, Oct. 1957. A simple mathematical model has been derived to predict the aerodynamic ablation of melting bodies. The ablation on a flat plate with a constant heat input has been derived in detail. Also for this case, the ablation after heat shut-off has been derived. Another case that has been studied is the ablation after a thermal pulse. A simple experiment was performed which ablates water from a slab, and the results of this experiment substantiate the theory qualitatively (no quantitative data was obtained). Many other useful and interesting cases may be solved using the theory, and these have been pointed out. (N-57193)

MOTION OF A BALLISTIC MISSILE ANGULARLY MISALIGNED WITH THE FLIGHT PATH UPON ENTERING THE ATMOSPHERE AND ITS EFFECT UPON AERODYNAMIC HEATING, AERODYNAMIC LOADS, AND MISS DISTANCE. Harry Julian Allen. NACA TN 4048, Oct. 1957. An analysis is given of the oscillating motion of a ballistic missile which upon entering the atmosphere is angularly misalined with respect to the flight path. The history of the motion for some example missiles is discussed from the point of the effect of the motion on aerodynamic heating and loading. The miss distance at the target due to misalinement and to small accidental angles is treated.

A STUDY OF THE MOTION AND AERODYNAMIC HEATING OF MISSILES ENTERING THE EARTH'S ATMOSPHERE AT HIGH SUPERSONIC SPEEDS. Harry Julian Allen and Alfred J. Eggers, Jr. NACA TN 4047, Oct.1957. A simplified analysis of the velocity and deceleration history of missiles entering the earth's atmosphere at high supersonic speeds is presented. The results of this motion analysis are employed to indicate means available to the designer for minimizing aerodynamic heating. The heating problem considered involves not only the total heat transferred to a missile by convection, but also the maximum average and local time rates of convective heat transfer.

RE-ENTRY AND RECOVERY. W. F. Hilton. (Paper given at the Cranfield Symposium, July 18-20,1957). Spaceflight, v.1, no.5, Oct.1957, p.174 (summary of paper). A suggested vehicle design is given in which, under re-entry conditions, the pilot's cabin and one entire surface of the vehicle are protected from extreme heating effects by being placed in an aerodynamic vacuum. The scheme is also based

DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.) - Continued

on the principle of producing maximum drag associated with maximum lift during re-entry (lift being in the downwards direction in the early stages of re-entry). The author concludes that the use of an aerodynamic vacuum to protect vital cargo is both novel and essential to successful re-entry from any altitude above a few hundred miles.

ON ABLATION AND MELTING STUDIES. Theodore E. Sterne. Watertown Arsenal Labs. WAL 892/16, June 1957. Experiments are discussed in which metal is melted by being shot from a gun at high velocity through air at sea level. It is shown that if the mathematical heat-flow problems can be solved, a knowledge of the distance from the gun at which melting first occurs, at various velocities, provides information on the heat-transfer coefficient. The physical nature of the melting process is also discussed, and some flame-heating experiments that may serve to provide transfer coefficients needed for other purposes, including possibility flame temperatures, are described and partially evaluated. (N-55104)

A METHOD FOR CALCULATING IMPACT POINTS OF BALLISTIC ROCKETS. Siegfried Fred Singer and R. C. Wentworth. Jet Propulsion, v.27, no.4, Apr.1957, p.407-409. A simple method is developed for determining impact points of ballistic rockets on a rotating earth. Rapid computation is facilitated by graphs giving time of flight between two chosen points of the elliptic trajectory. The method is applied to calculate the dispersion of an extreme high altitude unguided rocket.

STAGNATION POINT HEAT TRANSFER MEASUREMENTS IN DISSOCIATED AIR. Peter H. Rose and W. I. Stark. Avco Research Lab. Research Rept.3, Apr.1957 (rev.) The heat transfer at the stagnation point has been solved for several cases: (1) a boundary layer in thermal equilibrium throughout, (2) a boundary layer "frozen" at the chemical composition that it has at the edge of the boundary layer, and (3) a boundary layer wherein the fluid properties are permitted to adjust as dictated by a finite atomic recombination rate. This paper presents the methods and results of the experimental attack on this stagnation point heat transfer problem. (N-51906)

MOTION AND HEATING DURING ATMOSPHERIC RE-ENTRY. Alfred J. Eggers, Jr. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Report on an analysis made of the descent of a spherical earth satellite through the Earth's atmosphere with the purpose in mind of recovering the satellite intact.

DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.) - Continued

USE OF LIFT DURING RE-ENTRY. Antonio Ferri. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Report on possibilities of using aerodynamic lift to control aerodynamic loads and heat transfer to the vehicle. Involves decelerating the entry vehicle at sufficiently high altitudes by using lift and drag to keep it at high altitude where the air density is low, and consequently, the aerodynamic heating is low.

DECELERATION AND HEATING OF A BODY ENTERING A PLANETARY ATMOSPHERE FROM SPACE. Carl Gazley, Jr. (Presented at Convair-OSR Astronautics Symposium, Feb.18-20, 1957, San Diego). Rand Corp. P-955. The dynamics and thermodynamics of several types of entry into the atmospheres of Venus, Earth, and Mars are considered. Deceleration and heating are most severe for direct entry from a parabolic approach orbit. Appreciable reduction is obtained if the vehicle can be maneuvered into a circular satellite orbit; entry by decay from a circular orbit is more gradual and both deceleration and heating occur higher in the atmosphere. (CN-57816)

DESCENT FROM CIRCULAR ORBITS FOR VARIOUS ATMOSPHERES. Carl Gazley, Jr. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Analysis of the flight mechanics of entry to foreign planet atmospheres including Mars and Venus. Described "braking ellipse" approach to a planet. Compared heating rates which might be encountered in entering the atmospheres of Earth, Mars, and Venus.

AERODYNAMIC SOLUTIONS OF THE MANNED AND UNMANNED RE-ENTRY PROBLEM. Lester Lees. Astronautics symposium, held in San Diego, Feb.18-20, 1957, under sponsorship of Office of Scientific Res. and Convair. Report on analysis of the possibilities of using a "sweat" or transpiration cooling technique to reduce heat transfer to the skin of an entry vehicle. Such a scheme would involve forcing a liquid or gas through the porous skin of the vehicle. The use of lift during entry to control the flight path in such a way as to minimize aerodynamic loads and heating of the vehicle was suggested.

RE-ENTRY AND REAL GAS EFFECTS. Fred R. Riddell. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Effect of dissociation and ionization on high speed flight in the atmosphere. Results of experiments run using high pressure shock tubes to generate short duration, high temperature, airstreams. Analysis of radiative equilibrium temperature of an Earth satellite sphere descending through Earth's atmosphere.

DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.) - Continued

TRANSITION AND TURBULENT HEATING INCLUDING POSSIBLE REAL GAS EFFECTS. Edward Van Driest. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Paper discusses possible serious consequences of turbulent boundary layer flow over an entry vehicle since turbulent boundary layer heat transfer rates can exceed laminar rates by a factor of about 10 at entry speeds. Showed results of experiments using liquid nitrogen cooled cones in a supersonic wind tunnel.

VELOCITY OF A BODY FALLING THROUGH THE ATMOSPHERE AND THE PROPAGATION OF ITS SHOCK WAVE TO EARTH. G. V. Groves. Journal of Atmospheric & Terrestrial Physics, Feb.1957, pp.73-83. Theoretical investigation to find a solution for the velocity of a body falling to earth from a point outside the atmosphere. It is assumed that the flight path is a straight line inlined at an angle to the horizontal, that the drag coefficient is constant, that the gravitational acceleration is constant in the atmosphere, and that the scale height of the atmosphere is constant. Consideration is given to the effect of refraction arising from the temperature structure of the atmosphere on the shock wave generated by a vertically falling body.

HEAT TRANSFER TO SATELLITE VEHICLES RE-ENTERING THE ATMOSPHERE. N. H. Kemp and F. R. Riddell. Jet Propulsion, v.27, no.2, pt.1, Feb. 1957, p.132-137,147. Avco Research Lab. Research Rept.2, (N-51276) American Rocket Society Preprint 358-56 (N-51276A). Addendum to this paper by R. W. Detra, N. H. Kemp, and F. R. Riddell appears in Jet Propulsion, v.27, no.12, Dec.1957, p.1256-1257. Application of the Fay-Riddell theory of heat transfer at high velocities and high altitudes to the problem of a satellite vehicle entering the atmosphere. Circular re-entry orbits are considered for bodies under the influence of gravity and drag forces. Numerical results are presented which can be used to determine the conditions under which survival of such a satellite may be expected.

INVISCID HYPERSONIC FLOW PAST BLUNT BODIES. Stephen H. Maslen and Wolfgang E. Moeckel. (Presented at 25th annual meeting, IAS, Jan.28-31,1957). Institute of the Aeronautical Sciences, Inc. Preprint 665. Journal of the Aeronautical Sciences, v.24, no.9, Sept. 1957, p.683-693. (N-51499)

REENTRY OF SPHERICAL BODIES INTO THE ATMOSPHERE AT VERY HIGH SPEEDS. Krafft A. Ehricke. American Rocket Society Preprint 428-57, 1957.

A SURVEY OF HEAT TRANSFER PROBLEMS ENCOUNTERED BY HYPERSONIC AIRCRAFT.

DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.) - Continued

Jackson R. Stalder. American Rocket Society Preprint 457-57, 1957.

1956

A RECOVERABLE SCIENTIFIC SATELLITE. Carl Gazley, Jr. and David J. Masson. Rand Corp. RM-1844. Feb.27,1957 (revised). The uncontrolled descent of a satellite from its orbit involves a less severe heating problem than the re-entry of a long-range ballistic missile because of the more gradual descent and consequent smaller deceleration of the satellite. The satellite descent is slow enough so that the thin skin attains the radiation equilibrium temperature corresponding to a given velocity and altitude. (CN-49862X)

THE DECENT OF AN EARTH-SATELLITE THROUGH THE UPPER ATMOSPHERE. D. G. King-Hele. Journal of the British Interplanetary Society, v.15, no.6, Nov.-Dec.,1956, p.314. Analysis of the flight path of an uncontrolled but aerodynamically stable satellite as it spirals down through the Earth's atmosphere from an initially circular orbit under the action of air drag. The Earth and its atmosphere are taken as spherically symmetrical. For altitudes above 125 nautical miles a simple solution is found. It is shown that the velocity of the satellite is independent of its size, shape, weight, and initial altitude, and equal to the orbital velocity appropriate to its current altitude its angle of descent, in radius, is twice its drag/weight ratio. Estimates are also presented for the satellites lifetime. (N-48685).

INVESTIGATION OF THE YAW OF MISSILES RE-ENTERING THE ATMOSPHERE. Charles H. Frick. Naval Proving Ground, Dahlgren NPG Rept.1497, Nov.20, 1956. (N-53535)

A SIMPLE METHOD FOR COMPUTING THE TEMPERATURE HISTORY OF A BODY ENTERING THE ATMOSPHERE AT HIGH SUPERSONIC VELOCITIES. Gibson Oakes. Jet Propulsion, v.26, no.10, pt.1, Oct.1956, p.888-891. A simplified method for determining the temperature history of any point on a reentry body is presented. This method relates to atmospheric entry under any assigned values of prescribed initial conditions such as altitude, velocity and path angle. A procedure for numerical integration is outlined so that a solution can be readily programmed on the IBM 701 digital computer.

LUNAR INSTRUMENT CARRIER - LANDING FACTORS. H. A. Lang. Rand Corp. RM-1725. June 4, 1956. This report considers the problems of landing the instrument package portion of the rocket on the moon's surface in good operating condition. This will require that the instrument package come to rest in an upright position so that its aerial can function properly. The factors governing successful landing are nature and crushing strength of

DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.) - Continued

the moon's surface, and the weight, velocity, shape, strength of the moon's surface, and the weight, velocity, shape, strength and angle of impact of the instrument package. The present paper emphasizes landing situations for a vehicle decelerated by a braking rocket prior to impact. Unconventional landing possibilities are compared briefly. (CN-57707)

EXTREME SPEEDS AND THERMODYNAMICS STATES IN SUPERSONIC FLIGHT. (Extreme Geschwindigkeiten und thermische Zustande beim Uberschallflug). Klaus Oswatitsch. German text. Zeitschrift fur Flugwissenschaften, v.4, no.3/4, Mar.-Apr.,1956, p.95-108. (CN-45660)

SKIN TEMPERATURE VARIATION DURING RE-ENTRY OF SCIENTIFIC SATELLITE. D. J. Masson. Rand Corp. RM-1693, Mar.30,1956. The skin temperature variations during the descent of the scientific satellite from its orbit have been compared for 20- and 30-inch-diameter spheres. The skin materials considered are magnesium thorium, beryllium, and aluminum. The skin temperatures at the stagnation point of a nonspinning sphere and the average temperature of a spinning sphere were computed. This gave the upper and lower limits of skin temperature to be expected. (CN-47769)

SKIN HEATING DURING REENTRY OF SATELLITE VEHICLES TO THE ATMOSPHERE. Terence R. F. Nonweiler. (Presented at 7th. International Astronautical Congress, Rome, 1956.) Journal of the British Interplanetary Society, v.16, no.1, Jan.-Mar. 1957, p.10. Paper confined to discussing the limit of the maximum temperature reached close to the wing leading edge in sustained level flight at orbital speeds, as imposed by the action of conduction of heat within and along the skin.

AEROTHERMAL PROBLEMS. Morton Finsten. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book.)

AERO-THERMODYNAMICS OF DESCENDING ORBITAL VEHICLES. Krafft A. Ehricke. Astronautica Acta, v.2, no.1, 1956. (N-58394).

UPPER BOUNDS AND CONSERVATIVE ESTIMATES FOR AERODYNAMIC HEATING AT GREAT ALTITUDES. F. Vandrey. American Rocket Society Preprint 314-56, 1956.

1955

A METHOD FOR SIMULATING THE ATMOSPHERIC ENTRY OF LONG-RANGE BALLISTIC MISSILES. Alfred J. Eggers, Jr. NACA RM A55I15, Dec.28,1955. It is demonstrated with the aid of similitude arguments that a model

DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.) - Continued

fired from a hypervelocity gun upstream through a special supersonic nozzle should undergo motion and experience aerodynamic heat and resulting thermal stresses like those encountered by a long-range ballistic missile entering the earth's atmosphere. This combination of hypervelocity gun and supersonic nozzle is therefore termed an "Atmospheric Entry Simulator".

ON MECHANICS OF DESCENT TO CELESTIAL BODY. Krafft A. Ehricke. Journal of Astronautics, v.2, no.4, Winter 1955, p.137-144. American Rocket Society, Preprint 146A-54. Descent under conditions of departure from great circle flight; investigation of effect of deviation from great circle of flight in terms of increase of apparent weight and orientation of supporting force as function of flight speed and radius of curvature of deviating path.

AN INVESTIGATION OF THE MELTING OF BODIES DUE TO AERODYNAMIC HEATING. C. H. McLellan. Amer. Soc. of Mech. Engineers, Trans., v.77, no.5, July 1955, p.727-733. ASME Paper 54-A-157.

THE RECOVERY OF A SATELLITE VEHICLE. Kurt R. Stehling. American Rocket Society, Paper 280-55, 1955.

1954

CRUCIAL PROBLEMS IN ASTRONAUTICS: RECOVERY OF MULTISTAGE VEHICLES G. Arturo Crocco. Jet Propulsion, v.24, n.5, Sept-Oct.1954. pp.313-5. Advantages of cautious step-by-step program of developing and proof testing multistage orbital vehicles; each stage must be complete flying machine capable of ascending into space and returning safely to earth; problems of high speed descent through atmosphere and means of avoiding destructively high temperatures.

RETURN OF WINGED DEVICES FROM OUTER STATION PATHS. (Die Rückerkehr von geflügelten Geräten von Aubenstationsbahbeb). H. J. Kaeppeler and M. E. Kübler. (German text). Fifth International Astronautical Congress, Innsbruck, Aug.5-7,1954, p.120-149. (N-46768)

A COMPARISON OF HEAT TRANSFER CHARACTERISTICS OF THREE AERODYNAMIC SHAPES FOR RE-ENTERING EARTH'S ATMOSPHERE AT MACH 12. W. S. Bradfield and J. G. Ballinger. Rosemount Aeronautical Labs., U. of Minn. Eng. Memo. 23, Aug.1954. (N-41408). Journal of the British Interplanetary Society, v.14, no.4, July-Aug.1955, p.185-203. (N-41408a)

1952

A METHOD OF LANDING A SPACE SHIP UNDER ADVERSE CLIMATIC CONDITIONS. M. Couley. Journal of Space Flight. v.4, no.5, May 1952, p.6.

DESCENT FROM ORBIT (Including problems of re-entry, landing, recovery, etc.) - Concluded

1951

THE RETURN OF A WINGED ROCKET VEHICLE FROM A SATELLITE ORBIT TO THE EARTH. Wernher von Braun. Proceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9,1951. University of New Mexico Press, 1952, p.432-440. (629.13256 P56)

LANDING OF SPACECRAFT. E. G. Ewing. PRS Bulletin, v.4/12, Nov.1951.

DESCENT FROM SATELLITE ORBITS USING AERODYNAMIC BRAKING. Terence R. F. Nonweiler. Second International Congress on Astronautics, London, sponsored by the British Interplanetary Society, Sept.3-8,1951. Describes the application of some of the author's work to the problem of the descent of an aircraft from a circular orbit; when the aircraft reaches the denser regions of the atmosphere it is assumed that the remainder of the descent is a shallow dive during which the aircraft is supported by the lift from its wings and gradually slows down. This theoretical work is intended to provide an estimate of the temperature reached by an aircraft in this glide.

LANDING OF SPACE CRAFT. E. V. Sawyer. Paper read at Second International Congress on Astronautics, London, Sept.3-8,1951. The first problem is that of landing on the earth. The amount of energy required to put a vehicle from a circular orbit into an elliptical one is known but the best way to get from the perigee of the elliptical orbit to earth is still largely unknown. Aerodynamic drag appears to be the simplest method, perhaps preceded by rocket braking in order to reduce the total time of landing. A parachute seems to be the lightest form of aerodynamic braking.

AERODYNAMIC HEATING AT HIGH SPEEDS. Terence R. F. Nonweiler. Journal of the British Interplanetary Society, v.10, n.4, pp.160-176. July 1951.

PROBLEMS OF MISSILES ENTERING ATMOSPHERE. Terence R. F. Nonweiler. Journal of the British Interplanetary Society, v.10, no.1, Jan.1951, pp.26-35. It is usually supposed that spaceship making return journey must destroy its energy by same mechanism as it was derived; it is suggested that such measure, with all its implied complications, is unnecessary because atmosphere can provide required retardation without introducing any insuperable difficulties.

CONFIGURATION AND DESIGN (Including problems of structures, materials, fabrication, etc; designs for various purposes, such as, space stations, orbital bases, etc.)

1958

BERYLLIUM: PROMISING METAL OF THE SPACE AGE. Reginold E. Foster, and Louis A. Riedinger. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31,1958. General weight, strength, and thermal properties of beryllium are discussed. Examples of beryllium application are given which show reduction of weight and thermal stresses in high-temperature environments. Specific weight reductions are demonstrated for a ballistic missile and a lunar rocket.

FABRICATING THE REDSTONE MISSILE. Steel, v.142, no.3, Jan.20,1958, p.66-71.

MANNED SATELLITE STATION. R.A. Smith. (In Space Research and Exploration, edited by D.R. Bates). 1958. (629.1388 B31)

1957

METALS FOR SPACE TRAVEL. F.L. LaQue. Steel Processing and Conversion, v.43, Dec.1957, p.691-694,709-710 (Appears as abstract in Metals Review, v.31, no.2, Feb.1958, p.31-32). Materials discussed are Mg alloy HK 31; Al 2024; stainless steel 17-7 PH; Inconel "X"; hardenable Invar; Ti, Mo.

THE NEW DIMENSION. THE LAUNCHING OF THE SOVIET EARTH SATELLITES. Interavia, v.12, no.12, Dec.1957, p.1229-1233. Includes comparative data for Sputnik I, Sputnik II and Vanguard.

THE USEFUL HEAT CAPACITY OF SEVERAL MATERIALS FOR BALLISTIC NOSE-CONE CONSTRUCTION. Jackson R. Stalder. NACA TN 4141, Nov. 1957, 19p. Analysis of the heat-absorption characteristics of Cu, Inconel-X, graphite, and Be indicates that significant weight saving could be achieved in a ballistic missile heat sink by the use of graphite or Be in place of Cu.

GOODYEAR PROPOSES SMALLER SPACE STATION. Aviation Week, v.67, no.15, Oct.14,1957, p.115, 117, 119,123.

THE WEIGHT OF MINIMUM-COST ORBITAL FERRY VEHICLES. B. Bergqvist. Paper given at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957. Summarizes the numerical results that have been obtained by a method, developed by the Swedish Interplanetary Society's project study team, of determining the minimum weight of orbital ferry rockets. The work is being continued to cover more economic thrust programmes and step configurations.

CONFIGURATION AND DESIGN - Continued

METEOR JUNIOR, A PRELIMINARY DESIGN INVESTIGATION OF A MINIMUM-SIZED FERRY ROCKET VEHICLE OF THE METEOR CONCEPT. Darrell C. Romick, Richard E. Knight, and S. Black. Paper given at the 8th International Astronautical Congress, Barcelona, Oct.6-12,1957. American Rocket Society Preprint 504-57. A previous paper outlined a concept for a large ferry rocket vehicle and manned earth-satellite terminal, designated meteor. This paper presents a preliminary design investigation for a minimum-sized vehicle of the same concept. While exhibiting less load-carrying efficiency than the large vehicle, this smaller 500-ton vehicle could still carry a small operating crew and around a ton of payload.

ON THE GENERATION OF TEMPERATURES TO 30,000 DEG. K. P.E. Glaser. (Paper given at the Eighth IAS, Barcelona, Oct.6-12,1957). American Astronautical Society, Annual meeting, New York, Jan.29-31,1958. Data on the behavior of materials at high temperatures are needed for achieving high-temperature test apparatus in the range of 2,000-5,000 deg.K.: furnaces (electric resistance, induction, arc, solar), high-intensity electric arcs, flames, combustion of molten metals, shock tubes, ultra-high-frequency arc discharges, plasma jets, thermonuclear reactions.

A COMPARATIVE ANALYSIS OF THE PERFORMANCE OF LONG-RANGE HYPERVELOCITY VEHICLES. A.J. Eggers, Jr., H.J. Allen, and S.E. Neice. NACA TN 4046. Oct.1957. A simplified analysis is made of the motion and aerodynamic heating of long-range ballistic-, skip-, and glide-type vehicles. The ballistic vehicle appears relatively attractive because convective heat transfer can be reduced by using blunt shapes. The glide vehicle appears attractive because it has a relatively efficient trajectory, and the possibility of substantial radiative cooling.

PROJECT FAR SIDE. Siegfried Fred Singer. Missiles and Rockets, v.2, no.10, Oct.1957, p.120-122, 124-128. Man's first stride into space uses off-the-shelf hardware.

SKIN TEMPERATURES OF A SATELLITE. Craig M. Schmidt, and Arnold J. Hanawalt. Jet Propulsion, v.27, no.10, Oct.1957, p.1079-1083. American Rocket Society. Paper 383-56. The present paper gives numerical computations for a particular configuration that is considered feasible for a satellite design. The example investigated is a nonrotating cylindrical shell with one end pointing earthward. (CN-57885)

OBSERVATIONS ON ABLATION AND METALLURGICAL EFFECTS PRODUCED BY SURFACE HEATING OF THE ALGOMA METEORITE. Robert R. O'Neil. Smithsonian Institution Scientific Rept.1, Aug.26,1957. (CN-56806)

CONFIGURATION AND DESIGN - Continued

DESIGN PROBLEMS OF LARGE ROCKETS. K.J. Bossart. (Paper given at the Cranfield Symposium, July 18-20,1957). Spaceflight, v.1, no.5, Oct.1957, p.174 (summary of paper) For fully similar vehicles cross-sectional area is proportional to length^2 whereas thrust is proportional to length^3. For large vehicles this tends to cause an increase in structure weight from stressing considerations, and hence a departure from true similarity. On the other hand, aerodynamic heating is a less severe problem with large vehicles. Additional factors to be considered are vehicle stability and control, effect of size on optimum flight path, and problems of handling.

BRITISH UPPER ATMOSPHERE SOUNDING ROCKET. W.H. Stephens. (Paper given at Cranfield Symposium, July 18-20,1957). Spaceflight, v.1, no.5, Oct.1957, p.174 (summary of paper). The Skylark vehicle and its motor were described. Skylark is designed to carry payloads of 100-150 lb. to a height of 95 miles. To increase altitude performance, several changes in design are planned. With a small separating boost motor, the maximum height should be raised to 130 miles.

HIGH TEMPERATURE MATERIALS IN RELATION TO THE SATELLITE RE-ENTRY PROBLEM. P. Murray. (Paper given at Cranfield Symposium, July 18-20,1957). Spaceflight, v.1, no.5, Oct.1957, p.175 (summary of paper). It is considered necessary that the vehicle shell should be metallic, and it must therefore be protected by a layer of insulating material. Abrasion of the insulating material by the high-speed air flows necessitates covering it with an expendable metallic surface, or developing a method of fusing the insulation to produce a tougher surface.

WEIGHT ASPECTS OF THE EARTH SATELLITE LAUNCHING VEHICLE. (PROJECT VANGUARD). Louis K. Hennighausen. (Presented at 1957 National Conference of SAWE, Wichita, Apr.29 to May 2, 1957. Society of Aeronautical Weight Engineers. (CN-55443)

EVALUATION OF THE ABSORPTIVITIES OF SURFACE MATERIALS TO SOLAR AND TERRESTRIAL RADIATION, WITH PLOTS OF THE REFLECTANCES (AT WAVELENGTHS OF 0.4 TO 25μ) FOR TEN SAMPLE MATERIALS INCLUDING TWO TYPES OF FIBROUS-GLASS-REINFORCED PLASTIC. W.S. Shipley. Jet Propulsion Lab., Calif. Inst. of Tech. PR 20-319. Apr.11,1957. A graphical evaluation was made of the absorptivities of 6 samples of stainless steel, both coated and uncoated, to solar and terrestrial radiation. The reflectances for 10 sample materials suitable for use on an orbiting vehicle were measured at selected wavelength intervals between 0.4 and 25μ. (CN-56426)

CONFIGURATION AND DESIGN - Continued

THE TEMPERATURE BALANCE. John E. Naugle. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponshorship of Office of Scientific Res. and Convair. The energy balance of a body out of space is difficult to maintain. A suitable surface material subjected to X-rays, ultraviolet radiation, corpuscular radiation, high energy ions and meteoric bombardment in space may or may not maintain its delicately selected characteristics of emission and absorption so essential to the maintainence of proper temperature in a space vehicle.

VIBRATION MEASUREMENTS ON THE VANGUARD VEHICLE. Chester Bewick Cunningham. Office of the Secretary of Defense, Shock and Vibration Bulletin No.24, p.27-32, Feb.1957. Described here are possible sources of shock and vibration of the satellite to be launched by the Vanguard vehicle. Available data on the vibration and noise levels measured during captive firings of the second and third stages are presented, along with available power density spectra. (N-51366)

STUDIES OF RANDOM VIBRATION. Merval W. Oleson, and Ralph Edgar Blake. Office of the Secretary of Defense, Shock and Vibration Bulletin no.24, p.133-142. Feb. 1957. For the Vanguard satellite project studies were made of problems dealing with random-vibration testing. Progress is reported on the following topics: whether peak-notch filters are needed to correct for limited output impedance of a vibration table, calculation of amplifier power required to produce random-vibration with an electromagnetic shaker, advantages of a swept-band random-vibration test, and a new "equivalent sinusoidal test" to simulate the effect of random vibration. (N-51366)

DESIGN, FABRICATION AND TESTING OF FIRST MAN-MADE SATELLITE. (PROJECT VANGUARD). Robert Bauman. American Rocket Society Preprint 427-57, 1957.

STUDIES OF A MINIMUM ORBITAL UNMANNED SATELLITE OF THE EARTH (MOUSE), PART 3: RADIATION EQUILIBRIUM AND TEMPERATURE. D.T. Goldman, and S.F. Singer. Astronautica Acta, v.3, no.2, 1957, p.110-129. Calculation of the equilibrium temperature based on the equality of heat input and heat output, i.e., a zero net flow of energy. Results are presented in the form of nomograms to aid in preliminary design. It is assumed that the heat conductivity within the satellite is perfect so that all portions are at the same temperature or, at least, that the skin temperature is even.

PROJECT SNOOPER. M.I. Willinski, and E. Orr. Amer. Rocket Soc., Preprint 419-57, 1957.

CONFIGURATION AND DESIGN - Continued

1956

METALWORKING TACKLES SATELLITE. Steel, v.139, no.16, Oct.1956. p.120-123. Production of rocket which in 1957 will deliver 21-lb. magnesium "moon" to altitude of 300 mi. where it will cruise around earth; steps to be employed in manufacture of shell; building of aluminum magnesium skinned launching vehicle which will be 3-stage rocket about 72 ft. long, weighing nearly 11 tons; testing of rocket structure.

SATELLITES. Jorgen Jensen. Aeronautical Engineering Review, v.15, no.9 Sept.1956, p.44-47. Navigation, Sept.1956, p.121-127. Engineering aspects of Vanguard project; auxiliary jets to establish roll stability; special radio transmitter to be tracking aid; style trends in space ships; problems of manned space travel.

PRINCIPIEELE MOGELIJKHEDEN VAN RUIMSTEVAART. J.M.J. Kody. Ingenieur, v.68, no.22, 24, June 1,1956, p.041-054, June 15, p.055-064, discussion, 064-069. Basic possibilities of space flight with aid of present technical and chemical means; scientific significance of unmanned rocket which can now be realized; more advanced projects such as manned satellite rocket and building of space ships considered. Bibliography.

THE MOON ROCKET. George H. Clement. Earth Satellites as Research Vehicles, Proceedings of the symposium held Apr.18,1956, Franklin Inst. Monograph 2. Vehicle may be considered in three phases (1) powered phase, during which the vehicle is accelerated to a high velocity a few 100 miles above the earth. (2) Unpowered phase, during which the vehicle follows a path whose shape determined by the influence of the gravitational fields of the earth and moon and by the vehicle's velocity and position at the end of powered flight. (3) the vehicle may be required to perform a maneuver near the surface of the moon to control the conditions of landing.

THERMAL CONTROL IN SPACE VEHICLE. John S. Prigge, Jr. and Paul E. Sandorff. Journal of Astronautics, v.3, no.1, Spring, 1956, p.4-8, 26. Use of "thermos bottle principle" in connection with Whipple meteor shield, seen as practical answer to isolation of vehicle proper from heating and cooling effects of thermal radiation; methods by which variety of requirements may be met are involved; it is concluded that thermal control in space vehicle is relatively easy engineering problem, but not without its penalties in form of design time, cost and weight.

CONFIGURATION AND DESIGN - Continued

THE TEMPERATURE OF AN ORBITING MISSILE. A(lbert) R. Hibbs. Mar.28,1956. Jet Propulsion Lab., Calif. Inst. of Tech. Progress Rept.20-294. To prevent extensive temperature on satellite radio equipment, the analysis shows (1) how the average temperature of the outer shell can be controlled (for a given missile shape orientation, & trajectory) by a choice of surface coatings, and (2) that the limits of temperature variation of the enclosed equipment can be held to within a few degrees of this average shell temperature by adequate insulation. (N-44620)

VEHICLE DESIGN SPECIFICATIONS (FOR A SATELLITE). Paul E. Sandorff. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

STRUCTURAL CONSIDERATIONS IN SPACE VEHICLE DESIGN. Paul E. Sandorff. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

1955

GENERAL CHARACTERISTICS OF SATELLITE VEHICLES, PART 2. Norman V. Petersen. Journal of Astronautics, Fall 1955, p.105-110. Astronautics, v.2, nos.2-3, Summer and Fall 1955. Probability analysis in terms of size, launching site, and altitude, with a description of the von Braun satellite vehicle.

REPORT ON RESEARCH IN METAL PHYSICS FOR ROCKETS. B. Langenecker. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

POWERED SATELLITE VEHICLES. Krafft A. Ehricke. (Presented at 6th International Astronautical Congress, Copenhagen, Aug.1-6,1955).

ENGINEERING PROBLEMS OF MANNED SPACE FLIGHT. Krafft A. Ehricke. Interavia, v.10, no.7, July 1955, p.506-511. Considers flight into space and the rocket's descent to earth, establishment in space, operation in space, and trip to other celestial bodies.

A NEW DESIGN FOR THE SPACE STATION. Kenneth Durbin. J. of Space Flight, v.7, no.1, Jan.1955, p.1-6.

APPLICATIONS AND DESIGN CHARACTERISTICS OF MINIMUM SATELLITES. Siegfried Fred Singer. American Rocket Society Preprint 278-55, 1955.

CONFIGURATION AND DESIGN - Continued

SATELLOID. Krafft A. Ehricke. American Rocket Society. Paper 235-55, 1955, Astronautica Acta, v.2, no.2, p.63-100, Aero Digest, v.73, no.1, July 1956, p.46-48, 50, 52, 54. Theoretical analysis of powered, orbiting vehicle, designated as satelloid in distinction from (nonpowered) satellite; operational altitude lies above that of aerodynamic rocket glider and below that of satellite, in region between 350,000 and 450,000 ft.; satelloid can be useful for extended and global exploration of chemopause and lower ionosphere. Bibliography.

PRELIMINARY ENGINEERING STUDY OF A SATELLITE STATION CONCEPT AFFORDING IMMEDIATE SERVICE WITH SIMULTANEOUS STEADY EVOLUTION AND GROWTH. Darrell C. Romick. American Rocket Society Preprint 274-55, 1955.

MOUSE, MINIMUM ORBITAL UNMANNED SATELLITE OF EARTH FOR ASTROPHYSICAL RESEARCH. Siegfried Fred Singer. Journal of Astronautics, v.2, no.3, 1955, p.91-97. American Rocket Society Preprint 195-55. Evidence given to show that project is not only within range now, but should be and can be built now, with available technical facilities; purpose and advantages; how it will travel; path of orbit; construction details including instruments and telemetering; cost and time schedule.

1954

A PRELIMINARY DESIGN STUDY OF A THREE STAGE SATELLITE FERRY ROCKET VEHICLE WITH PILOTED RECOVERABLE STAGES. Darrell C. Romick, Richard E. Knight, and John M. Van Pelt. American Rocket Society Paper 186-54. Dec.3,1954. Each separate vehicle in this system has delta wings and nose doors which close upon separation from the next stage, and an extendable landing gear. Thus, each vehicle, when its main function is completed, converts to a glide type aircraft, and its crew guides it to a landing at a base where jet engine pods and other minor parts are installed so that the crew may then fly it back to the launching base as an airplane. (CN-49370)

NEW SUPPLY SYSTEM FOR SATELLITE ORBITS. Krafft A. Ehricke. Jet Propulsion, v.24, no.5 & 6, Sept.-Oct.,1954, p.302-9, Nov.-Dec. p.369-73, 465. Comment by Derek F. Lawden, in Jet Propulsion, v.24, no.6, page 382. System characterized by operational separation of cargo supply and passenger transport; supply ship has ballistic shape and is automatically guided into target orbit; passenger ship is equipped with winged upper stage; existance of optimum satellite orbits for departure and arrival of interplanetary expeditions demonstrated analytically; examples of guided supply vehicles and passenger ships.

CONFIGURATION AND DESIGN - Continued

DEVELOPMENT OF MATERIALS WHICH ARE RESISTANT TO HIGH TEMPERATURES, FOR AVIATION AND SPACE TRAVEL. (DIE ENTWICKLUNG HOCH TEMPERATURBESTANDIGER WERKSTOFFE FUR DIE LUFT AND WELTRAUMFAHRT). (GERMAN TEXT). E. Fitzer. Fifth International Astronautical Congress, Innsbruck. Aug.5-7,1954, p.190-209. (N-46768)

MINIMUM ORBITAL INSTRUMENTED SATELLITE - NOW. Siegfried Fred Singer. British Interplanetary Society Journal, v.13, no.2, Mar., 1954, p.74-79. Within few years technology of building large rockets will have advanced to stage where one can actually put very small body into orbit around earth; MOUSE (Minimum Orbital Unmanned Satellite, Earth) would weigh about 100 lb; one should be prepared to have it orbit for only a short time and then loose it; with only small payload of scientific instruments, information could be obtained on solar radiations of immense importance to radio communication and to problem of weather.

RELIABILITY OF SPACE SHIP DESIGN. Vincent Story. Journal of Space Flight, v.6, no.2, Feb.1954, p.2.

STRUCTURAL PROBLEMS OF THE LUNAR BASE. P.L. Sowerby. Journal of the British Interplanetary Society, v.13, no.1, Jan.1954, p.36-40. The choice of site and surveying in relation to lunar conditions is considered. The use of lunar materials, the possibility of making cement from lunar minerals, and uses of concrete on the Moon are also dealt with. Thermal protection is necessary. Pressure domes may be constructed of glass fibre cloth, with a maximum practical size of 100 feet diameter hemisphere, weighing about 9 tons. It is concluded that the lunar base will be almost entirely underground, any surface pressurized works being of glass cloth.

BASIC DESIGN PRINCIPLES APPLICABLE TO REACTION-PROPELLED SPACE VEHICLES. Darrell C. Romick. (Presented at 5th International Astronautical Congress, Innsbruck, 1954). International Astronautical Congress, Proceedings, 1954, p.81-99. The paper develops the fundamental relationships governing the kinetic behavior of ships in free space, along with a method for using them. A sample preliminary design utilizing this method is presented for a 1000 ton high performance space ship incorporating a linear electronic accelerator drive, which is also described. (CN-54335)

1953

FABRICATION OF ORBITAL VEHICLE. Kenneth W. Gatland, A.M. Kunesch, and Alan E. Dixon. British Interplanetary Society Journal, v.12, no.6, Nov.1953, p.274-85. Space vehicle using liquid chemical propellant considered as means of obtaining manned reconnaissance of moon; methods of assembling vehicle in close satellite orbit from prefabricated parts carried out to base orbit by 500-ton freighter rockets; light jig recommended to

facilitate assembly operations in space.

A CONSIDERATION OF SPACESHIP SHAPE. R. Cox Abel. Aeronautics, v.29, no.2, Sept.1953, p.164-168. This article shows that a spaceship can be likened to a building or other mass supported by forces at one end. The principles of its structure are therefore tower-like.

THE FABRICATION OF THE ORBITAL VEHICLE. A.E. Dixon, K.W. Gatland, and A.M. Kunesch. 4th International Astronautical Congress, held at Zurich, Aug.3-8, 1953. By assembling a vehicle in space in a circumterrestrial orbit, it would be possible to try a three-man mission to the moon. Details discussed for fabricating an orbital vehicle which can be assembled in space.

1952

VON BRAUN OFFERS PLAN FOR STATION IN SPACE. Wernher von Braun. Aviation Age, vol.18, no.6, Dec.1952, p.61-63. Presents early steps for establishment of a space station which needs to be a well-coordinated project necessitated by magnitude of the task. Suggests a study schedule to explore all phases of the problem and the development and testing program.

A PRELIMINARY SURVEY OF THE CONSTRUCTIONAL FEATURES OF SPACE STATIONS. Harold B. Ketchum. Journal of Space Flight, v.4, no.8, Oct.1952, p.1-4. Design features of a robot station: hull design, instruments to be installed, telemetering equipment, continuous energy, propulsion and robot control mechanisms.

ESTABLISHMENT OF LARGE SATELLITES BY MEANS OF SMALL ORBITAL CARRIERS. (ENGLISH TEXT AND GERMAN SUMMARY). Krafft A. Ehricke. Proceedings of the Third International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.111-145. (N-53323)

THE SATELLITE ROCKET, 1952. (DIE SATELLITENRAKETE 1952). (GERMAN TEXT AND ENGLISH SUMMARY). Helmut Hoeppner. Proceedings of the Third International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.97-105. After the design of the Satellite Rocket 51 other projects have been developed by other engineers which show that the design of the SR 51 was a suitable project for its purpose and mature for advanced development. The project SR 52 treats details which up till now were neglected in the SR 51 and all other designs, which however are vitally important for a successful satellite program. There are, mainly, the requirements for safety in takeoff. (N-53323)

CONFIGURATION AND DESIGN - Continued

INTERORBITAL TRANSPORT TECHNIQUES. (WITH SPECIAL REFERENCE TO SOLAR DERIVED POWER). H. Preston-Thomas. Brit. Interplanetary Society Jour. v.11, no.4, July 1952, p.173-193. Discusses types of ships that could operate from satellite station, collect raw materials and return to earth.

A METHOD OF USING SMALL ORBITAL CARRIERS FOR ESTABLISHING SATELLITES. Krafft A. Ehricke. American Rocket Society Paper 69-52. 1952. Discusses transfer of satellite-bound payload in auxiliary orbit, selection of satellite orbit and auxiliary orbits, satellite ship and orbital carrier, ascent of the orbital carrier, direct powered ascent, and other pertinent topics.

1951

THE INFLUENCE OF THE LAYOUT OF THE SPACE-STATION ON THE OVERALL COSTS OF THE PROJECT. Heinz H. Koelle. Second International Congress on Astronautics, held in London by British Interplanetary Society, Sept.3-8,1951. The paper defines the space-station and discusses the task it will have to fulfill during all states of its development. A general equation for calculating construction and maintenance costs is derived. In particular it is shown that the design of the cargo rocket and the space-station must be considered together to obtain the most economical solution.

THE FOUNDATION OF THE SPACE-STATION. Guido von Pirquet. Second International Congress on Astronautics, held in London by British Interplanetary Society, Sept.3-8,1951. First step towards establishing a space-station would be the "long-distance rocket" which would have a maximum range of about one half the earth's circumference. The space station would have a number of uses - as an astronomical observatory, for astrophysical spectro-analysis, for radio and television transmission and weather observation. It would be of inestimable value for refuelling space-ships.

THE OPTIMUM SATELLITE FREIGHT ROCKET. Helmut Hoeppner. Second International Congress on Astronautics, held in London by the Brit. Interplanetary Soc., Sept. 3-8,1951. A 4-step rocket is described capable of carrying a freight load of 3.5 tons into an orbit at an altitude of 1,669 km.

PROPOSAL FOR THE CONSTRUCTION OF A SPACE-STATION. A. Pullenberg. Paper read at Second International Congress on Astronautics, London, Sept.3-8,1951. A two-step rocket is proposed with expendable tanks in the first step. In this type of construction the tanks are cast off as used and thereby a good mass ratio is obtained. The second step uses the same propulsion equipment as the first step and is used as the basis for the space-station. Supply rockets are used to complete the structure of the station. The use of a collapsible balloon-like

structure is suggested which could be inflated in space and sprayed with a plastic material in order to form cell-units for the station.

HOW WILL THE SPACE STATION BE CONSTRUCTED. R. Nebel. Second International Congress on Astronautics, London, 1951, Symposium on Satellite Vehicles. Summary in Brit. Interplanetary Soc. Jour. v.10, no.6, Nov.1951, p.304. Early work at the Raketenflugplatz reviewed by the author who indicates his opinions regarding design of space station to be essentially unchanged from original proposal in 1932.

1949

DESIGN OF A PRACTICAL SPACE SHIP. Wayne Proell. Chicago Rocket Society, Collection Tech. Repts., v.3, 1951, p.27. Journal of Space Flight, v.1, nos.4-6, Sept.-Nov.,1949.

THE MODEL PROGRAMME. Journal of the British Interplanetary Society, v.8, no.4, July 1949, p.162-165. Variation of orbital techniques for a model of Circum-Lunar Rocket designed by "certain members of the Technical Committee" (BIS)

ORBITAL BASES. Harry E. Ross. Brit. Interplanetary Soc. Journal, v.8, no.1, Jan.1949, p.1-19. Operational and personnel requirements, and navigational difficulties for the maintenance of manned stations. Describes Ross-Smith single self-contained space station consisting of a mirror, living quarters and an arm, at the far end of which is a radio aerial array.

1948

TEN ARTICLES REPRINTED FROM NATUR UND TECHNIK, ESPECIALLY: THE OUTER-STATION, SPRINGBOARD INTO SPACE. Guido von Pirquet. Zehn Beiträge, Herausgegeben von der Gesellschaft für Natur und Technik, Verlagsbuchhandlung Natur und Technik, Vienna, 1948, 52p.. Discusses the advantages of orbital refuelling.

THE MAN-CARRYING ROCKET. R.A. Smith. Journal of the British Interplanetary Society, v.7, 1948, p.101-111.

1947

SOME REMARKS ON THE TEMPERATURE PROBLEMS OF THE INTERPLANETARY ROCKET. Robert L. Sternberg. Journal of the American Rocket Society, v.70, June 1947, p.34.

1946

EFFECT OF SUN'S HEAT ON SPACE ROCKETS. G.C. Ellerton. Journal of the American Rocket Society, v.68, Dec.1946, p.27.

CONFIGURATION AND DESIGN - Concluded

1945

THE STATION IN SPACE; SUN POWER STATIONS PLANNED BY GERMANS. Journal of the American Rocket Society, Sept.1945, p.8-9. Captured German war secrets reveal their plans for a space station based on early theories of Noordung, Pirquet, Oberth, and others.

PROPULSION, ROCKET (CONVENTIONAL)

1958

INTERIOR BALLISTICS, ROCKET ENGINE, AND PROPELLANT STUDIES. John I. Shafer. (Lecture for course - Space Technology). University of California - Lecture 8A, Mar.10-14,1958.

FUNDAMENTAL PRINCIPLES OF ROCKET PROPULSION. Howard S. Seifert. (Lecture for course - Space Technology). University of California - Lecture 7A. Mar.3-7,1958.

PROPULSION SYSTEMS - LIQUID ROCKET ENGINES. George P. Sutton. (Lecture for course - Space Technology). University of California - Lecture 7B. Mar.3-7,1958.

POWER LIMITED FLIGHT IN FIELD FREE SPACE. David B. Langmuir. (Lecture for course - Space Technology). University of California - Lecture 5A. Feb.17-19, 1958. (Particularly on increasing exhaust velocities of rocket chemical rocket motors).

BOOSTER PROPULSION FOR SPACE VEHICLES. R.S. Wentink. (Presented at 26th annual meeting, IAS, Jan.27-30,1958). Institute of the Aeronautical Sciences. Preprint 828. (CN-58730)

ROCKET AND ROCKET PROPELLANTS. J. Humphries. (In Space Research and Exploration, edited by D.R. Bates). 1958. (629.1388 B31)

1957

THE CALCULATION OF FUEL DISTRIBUTION IN STEP-ROCKETS. M.L. Williams. Journal of the British Interplanetary Society, Oct.-Dec. 1957, p.211-215. Presentation of results indicating changes in Vertregt's analysis of the rocket performance that result from considering the dry mass to be composed of three parts: load-carrying structure, nonstructural weight, and power plant weight.

ON RELATIVISTIC ROCKET MECHANICS. J.M.J. Kooy. Paper given at the Eight International Astronautical Congress, Barcelona, Oct.6-12, 1957. Most authors treating rectilinear rocket flight in nongravitational space consider the rocket plus exhaust gases as a single mechanical system and apply the relativistic law of conservation of momentum. In this paper only the rocket plus still-contained propellants is considered as the mechanical system, and the differential equations for rectilinear and curvilinear motion in no-gravitational space are derived directly from the basic equation of relativistic mechanics. The astronautical aspects of relativistic time dilatation are discussed.

STABILITY INVESTIGATIONS ON LIQUID PROPELLENT ROCKET MOTORS WITH THE HELP OF THE "HARMONIC BALANCE" METHOD. G. Heinrich and W. Peschka. Paper given at Eighth International

PROPULSION, ROCKET (CONVENTIONAL) - Continued

Astronautical Congress, Barcelona, Oct.6-12,1957. An analysis of combustion instability in monopropellent motors using the harmonic balance method; only in two special cases can numerical solutions within reasonable limits be obtained.

FUTURE DEVELOPMENTS IN ROCKET PROPULSION BEYOND THE ATMOSPHERE. L.R. Shepherd. Symposium on high altitude and satellite rockets. Held at College of Aeronautics, Cranfield, approx. July 1957. Organized by Brit. Interplanetary Soc., College of Aeronautics and Royal Aeronautical Soc.

PROPULSION PROBLEMS OF HIGH ALTITUDE ROCKETS. A.D. Baxter. Symposium on high altitude and satellite rockets, held at College of Aeronautics, Cranfield, approx. July 1957. Organized by Brit. Interplanetary Soc., College of Aeronautics and Royal Aeronautical Soc.

SPACE DYNAMICS TECHNIQUE HINGES ON PROPULSION SYSTEMS. John DeNike, Jorgen Jensen, and Michael Stoiko. Aviation Age, July 1957, pp.26-31. Discussion leading to the conclusion that the three-step method of space travel will prevail as long as one is restricted to power plants that can be built in the near future, but that this classic scheme can be refined and simplified in the near future.

(A COMPARISON OF VARIOUS TYPES OF PROPULSION SYSTEMS, PRESENT AND FUTURE) (PROPULSION PANEL). Robert C. Truax. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and Convair. For propulsion in outer space the chemical rocket should be optimized in a different manner than the manner in which chemical rockets are currently built; namely, because of practically zero back pressure, it is possible to reduce the combustion chamber pressure to perhaps 2 atm. instead of 300-800 psi, which corresponds to 20-40 atm.

(A COMPARISON OF VARIOUS TYPES OF PROPULSION SYSTEMS, PRESENT AND FUTURE) (PROPULSION PANEL). Hans Von Ohain. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and Convair. Comprehensive survey of the various non-air breathing propulsion systems and the corresponding vehicles. Conclusion are that chemical propulsion systems will require elaborate staging for planetary or moon operations and return missions.

HOW DOES THE PROPULSION ENGINEER VIEW MANNED EXTRA-ATMOSPHERIC FLIGHT. Konrad K. Dannenberg. Army Ballistic Missile Agency. 1957. The purpose of this presentation is to analyze the status of existing propulsion systems and their usefulness for extra-atmospheric flight. (CN-54185)

PROPULSION, ROCKET (CONVENTIONAL) - Continued

DESIGN CONSIDERATIONS OF THE VANGUARD THIRD STAGE ROCKET ENGINE. Will Schaafsma. Amer. Rocket Soc., Preprint 423-57. (1957).

ROCKET IMPULSE SPECTRUM. M. Farber. Amer. Rocket Soc., Preprint 418-57. (1957).

1956

THE USE OF SOLID PROPELLANT ENGINES FOR ACHIEVEMENT OF SUPER VELOCITIES. Joseph W. Wiggins. Jet Propulsion, v.26, no.12, Dec. 1956, p.1084-1087.

COMBUSTION, APPLIED MECHANICS AND SPACE TRAVEL. L.E. Sedov. Rand Corp. RM-1922, p.145-149. Translation from New Times (Moscow), no.47, Nov.15,1956, p.29-30. (CN-47550, pt.2).

IMPORTANCE OF MASS RATIO AND ADAPTABILITY OF CASE BONDED SOLID PROPELLANT ROCKET SYSTEMS FOR ACHIEVEMENT OF SUPER VELOCITIES. Joseph W. Wiggins. American Rocket Society. Preprint 303-56. (1956). (CN-49414)

ROCKETRY. R. Tousey. Smithsonian Contributions to Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.39-44. (CN-53300, v.1, no.1)

FIRST STAGE PROPULSION - PROJECT VANGUARD. George L. MacPherson. American Rocket Society Preprint 385-56. (1956).

ROCKET ENGINE PERFORMANCE. Edward S. Taylor. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

SOLID PROPELLANT ROCKET ENGINES. Charles E. Bartley. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

LIQUID PROPELLANT ROCKET ENGINE DESIGN. Orien L. Hogan. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

1954

SPACE FLIGHT AND ROCKET PROPULSION. I, III, IV - THERMODYNAMICAL NOTIONS

PROPULSION, ROCKET (CONVENTIONAL) - Continued

APPLICABLE TO CHEMICAL ROCKET PROPELLANTS. J. Venter. Journal South African Interplanetary Society, Oct.-Dec.1954, Apr.-June, July-Sept.1955, pp. 51-64, 41-48, 68-81. Analysis of fundamental problems related to forms, transformation, and potentialities of energy; includes design and construction data for the supply system to the combustion chamber to feed the rocket motor with oxidizer and fuel at a desired rate to obtain maximum efficiency.

ON THE INFLUENCE OF RECOMBINATION ON THE PERFORMANCE OF LIQUID-PROPELLANT ROCKETS. (UBER DEN EINFLUB DER REKOMBINATION AUF DIE LEISTUNG VON FLUSSIGKEITS-RAKETEN). (German text). U.T. Boedewadt. Fifth International Astronautical Congress, Innsbruck. Aug.5-7,1954, p.183-188. (N-46768)

SOLID PROPELLANTS AND ASTRONAUTICS. Alfred J. Zaehringer. Fifth International Astronautical Congress, Innsbruck, Aug.5-7, 1954, p.13-17. It is shown that solid propellants can be useful for certain astronautical operations. A critical review of solid propellants and motor systems is presented. It is pointed out that solid propellants compare very favorably with liquid propellants especially for applications in high altitude rockets and in boosters for space aggregates. (N-46768)

1953

LIMITATIONS ON THE PERFORMANCE OF CHEMICAL ROCKETS IN ASTRONAUTICS. W.N. Neat. 4th International Astronautical Congress, Zurich, Aug.3-8, 1953. Chemical propellants could not allow a space ship to undertake a mission from the earth orbit to Mars with a landing on that planet and a subsequent return to the earth orbit.

1951

SURVEY OF DEVELOPMENT OF LIQUID ROCKETS IN GERMANY AND THEIR FUTURE PROSPECTS. Wernher von Braun. Journal of the British Interplanetary Society, Mar.1951, p.75-80.

1950

ALUMINUM BOROHYDRIDE AS A FUEL FOR SPACE SHIPS. Wayne Proell and Norman J. Bowman. Journal of Space Flight, v.2, no.1, Jan.1950, p.1-6. (N-14123)

HYDRIDES AND ORGANOMETALLIC COMPOUNDS AS A HIGH ENERGY ROCKET FUELS. Wayne Proell and Norman J. Bowman. Chicago Rocket Society, Collection Tech. Repts., v.4, 1953, p.8. Journal of Space Flight, v.2, 1950.

PROPULSION, ROCKET (CONVENTIONAL) - Concluded

1949

HIGH ENERGY CHEMICAL ROCKET FUELS. Norman J. Bowman. Chicago Rocket Society Collection Tech. Repts., v.3, 1951, p.57. Journal of Space Flight, v.1, no.7, Dec.1949.

1948

ROCKET PROPULSION. Kurt R. Stehling. Engineering Journal, v.31, no.3, Mar.1948, p.162-166. Considers rockets and future developments.

1947

INTRODUCTION TO THE PROBLEM OF ROCKET-POWERED AIRCRAFT PERFORMANCE. H. Reese Ivey, Edward N. Bowen, Jr., and Lester F. Oborny. NACA TN 1401, Dec.1947. An introduction to the problem of determining fundamental limitations on performance possibilities of rocket-powered aircraft is presented. Previous material on the subject is reviewed and given in condensed form along with supplementary analyses. Some of the problems discussed are: limiting velocity of a rocket projectile, limiting velocity of a rocket jet, jet efficiency, nozzle characteristics, maximum attainable altitudes, and range. Formulas that relate performance of a rocket-powered aircraft to basic weight and nozzle dimensional parameters are presented and illustrated.

PHYSICS OF ROCKETS: DYNAMICS OF LONG RANGE ROCKETS. (Part 3). Howard S. Seifert, Mark W. Mills, and Martin Summerfield. American Journal of Physics, v.15, no.3, May-June,1947, p.255-272. A rocket fuelled by nitric acid and aniline can take a payload of 100 lb and achieve orbital velocity if its initial mass is 54,000 lb.

1946

ROCKETS. INCLUDING "A METHOD OF REACHING EXTREME ALTITUDES" AND "LIQUID-PROPELLANT ROCKET DEVELOPMENT". R.H. Goddard. New York, 1946. American Rocket Society, 1946, 119 p.

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PROPULSION AND POWER SUPPLY (Other than conventional rocket)

1958

SOLAR SAILING - A PRACTICAL METHOD OF PROPULSION WITHIN THE SOLAR SYSTEM. Richard L. Garwin. Jet Propulsion, v.28, no.3, Mar.1958, p.188-190. Commercially available metallized plastic film can be used as a solar radiation pressure sail for propulsion of space vehicles within the solar system. The method of propulsion is of negligible cost and is perhaps more powerful than many competing schemes.

POTENTIAL APPLICATION OF NUCLEAR ENERGY TO SPACE. C. J. Wang, and G. W. Anthony. American Astronautical Society, Annual meeting, New York, Jan.29-31,1958. The potential performance of a rocket using the energy of nuclear fission to heat a bipropellant or a monopropellant is discussed as a function of the reactor core temperature. Various applications in the area of space vehicle propulsion are considered.

HYDROGEN PEROXIDE AS A SOURCE FOR OXYGEN, WATER, HEAT, AND POWER FOR SPACE TRAVEL. Noah S. Davis. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31,1958. Concentrated hydrogen peroxide is a stable high-density liquid which can be decomposed by means of a catalyst to produce pure oxygen and distilled water. During the decomposition, heat and power become available. This paper considers the use of hydrogen peroxide to produce oxygen and water and to provide heat and power for miscellaneous application.

ON PLASMA PROPULSION. Yusuf A.,Yoler, General Electric Co. American Astronautical Society, Annual meeting, New York, Jan.29-31,1958. The need for a technique of propulsion intermediate to that of chemical and ionic propulsion is indicated from the point of view of propulsion efficiency. A simple theoretical model on magnetohydrodynamic propulsion on breathing and rocket engines is set up, and results are presented indicating the significant parameters, the nature of magnetohydrodynamic power, and the feasibility of plasma propulsion.

PLASMA MOTORS. Winston H. Bostick, American Astronautical Soc., Annual meeting, held in New York, Jan.29-31,1958.

THE USE OF PLANETARY ATMOSPHERES FOR PROPULSION. Sterge T. Demetriades and Carl B. Kretschmer. American Astronautical Society, Annual meeting, New York, Jan.29-31, 1958. The upper atmosphere of a planet serves as a storage tank for the sun's energy, and so offers an inexhaustible supply of energy for propulsion and other purposes. It is possible that the ultraviolet emission of the sun produces useful quantities of free radicals and dissociated molecules in the atmospheres of the other planets. A provisional table of atmospheric compositions of the planets is presented.

PROPULSION AND POWER SUPPLY (Other than conventional rocket)- Continued

A SURVEY OF PROPULSION AND SPACE DYNAMICS. D. B. Cross and Jorgen Jensen. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31,1958.

CONTROLLED RELEASE OF THERMONUCLEAR ENERGY. Nature, v.181, no.4604, Jan.25,1958, p.217-233. Contents: Production of high temperatures and nuclear reactions in a gas discharge, by P. C. Thonemann, E. P. Butt, R. Carruthers, A. N. Dellis, D. W. Fry, A. Gibson, G. N. Harding, D. J. Lees, R. W. P. McWhirter, R. S. Pease, S. A. Ramsden and S. Ward. Co-operative phenomena in hot plasmas, by Lyman Spitzer, Jr. A stabilized high-current toroidal discharge producing high temperatures, by M. L. Allen, T. E. Allibone, D. T. Chick, R. F. Hemmings, T. P. Hughes, S. Kaufman, B. S. Liley, J. G. Mack, H. T. Miles, R. M. Payne, J. E. Read, A. A. Ware, J. A. Wesson and R. V. Williams. Magnetic measurement of plasma confinement in a partially stabilized linear pinch, by L. C. Burkhardt, R. H. Lovberg and J. A. Phillips. Neutron production in a high-power pinch apparatus, by D. C. Hagerman and J. W. Mather. New confinement phenomena and neutron production in a linear stabilized pinch, by L. C. Burkhardt and R. H. Lovberg. Neutrons from a stabilized toroidal pinch, by J. Honsaker, H. Karr, J. Osher, J. A. Phillips and and J. L. Tuck. (N-59129)

THE RAMJET IN ASTRONAUTICS. S. W. Greenwood. Spaceflight, v.1, no.6, Jan.1958, p.211-215, 219.

1957

OUTLOOK TO SPACE TRAVEL. Ernst Stuhlinger. Scientific Monthly, Dec.1957, p.218-287. Discussion of the planning of a round trip to Mars, with a detailed description of the electric space ship and its propulsion systems.

FUSION POWER. Richard F. Post. Scientific American, v.197, no.6, Dec.1957, p.73-84. If man can tame the reactions in which the nuclei of atoms are fused rather than split, he will have an almost limitless source of energy. The problem is now being attacked in laboratories all over the world. (CN-58357)

DESIGN AND PERFORMANCE DATA OF SPACESHIPS WITH IONIC PROPULSION SYSTEMS. Ernst Stuhlinger. Paper given at the 8th International Astronautical Congress, Barcelona, Oct.6-12,1957. American Rocket Society Preprint 509-57. The basic relations between component masses and performance figures of electrically-propelled space vehicles can be derived if a few simplifying assumptions are made. Even though many of the technical details of electric drive systems have not been developed, it is possible to estimate the take-off mass and initial acceleration of a spaceship as a function of its payload, total propulsion time and a few design parameters.

PROPULSION AND POWER SUPPLY (Other than conventional rocket) - Continued

CONTRIBUTION TO NUCLEAR AUTO-PROPULSION. J. J. Barre. Paper given at the Eighth International Astronautical Congress, Barcelona, Oct.6-12,1957. A nuclear reactor for rocket propulsion must function at a temperature approaching 3,000 deg. K. Possible developments include a combined engine nuclear reheat of the combustion gases, the use of superheat, the use of a fissionable gas (e.g., plutonium vapour).

EIN VERGLEICH MÖGLICHER ANTRIEBSSYSTEME FÜR RAUMFAHRZEUGE. George P. Sutton. Raketen tech. and Raumfahtforsch., Oct.1957. German text. Discussion of the actual propulsion systems for space vehicles including liquid power plants, nuclear propulsion, free radical (atomic gases), heating through solar energy, and electrical-discharge and Lorin propulsion.

SILICON SOLAR BATTERIES AS ELECTRIC POWER SOURCES FOR ARTIFICIAL EARTH SATELLITES. V. S. Vavilov, V. M. Malovetskaya, G. N. Galkin, and A. P. Landsman. (Presented at Conference on Earth Satellites, Washington, D.C., Oct.2-5,1957). U.S. Joint Publications Research Service, Rept.187, p.181-189 (N-58836,pt.1). Translation from Uspekhi Fizicheskikh Nauk, v.63, no.1a, Sept.1957, p.123-129. Description of the construction of the battery and a study of the conditions of its successful performance.

THE FLIGHT PATH OF AN ELECTRICALLY PROPELLED SPACE SHIP. Ernst Stuhlinger. Jet Propulsion, v.27, no.4, Apr.1957, p.410-414. Deals with the flight phases which are necessary and sufficient to achieve an expedition to Mars and back with a low-thrust, electrically propelled space ship. Trajectory calculations were made in a simplified manner. Although no optimization has been attempted. The results show that flight times and required maneuvers are well within the limits of feasibility. The trip to Mars takes 401 days, stay time on Mars is 472 days, and the trip back to earth lasts 311 days. Corrective maneuvers may require a few additional days. The problems of navigation can be solved with conventional methods.

THE FEASIBILITY OF THE NUCLEAR POWERED ION PROPELLED SPACE VESSEL. Donald McRae Mixson. Air Force Inst. of Tech. GNE-5. Mar.1957. The Ion and Chemical rocket are compared. The mass and electrical efficiency of the ion generator-accelerator system is determined, the mass of the DC generators is calculated, and the heat transfer is estimated. Finally the mass of shielding material required is calculated. The results show that a 100-ton ship is feasible. (CN-55120)

(A COMPARISON OF VARIOUS TYPES OF PROPULSION SYSTEMS, PRESENT AND FUTURE) (PROPULSION PANEL). George P. Sutton. Astronautics symposium, held in San Diego, Feb.18-20,1957. sponsored by Office of Scientific

PROPULSION AND POWER SUPPLY (Other than conventional rocket) - Continued

Res. and Convair. Covers various chemical propulsion systems. Conclusions are that presently known devices should make flight possible to the Moon, Mercury, Venus, and Mars; that multiple stage devices with reasonable flight times make it also theoretically possible to fly missions to Jupiter and Saturn; that there is no known power plant today which would permit trips to Neptune or Pluto or which would permit escape from the solar system in any reasonable length of time.

(A COMPARISON OF VARIOUS TYPES OF PROPULSION SYSTEMS, PRESENT AND FUTURE) (PROPULSION PANEL). Ernst Stuhlinger. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and Convair. Presented a chart which showed a comparison of the four propulsion systems; namely, chemical, nuclear solar power, nuclear power plus ions, and photonic. Reviewed briefly the trajectory of a photon rocket.

(A COMPARISON OF VARIOUS TYPES OF PROPULSION SYSTEMS, PRESENT AND FUTURE) (PROPULSION PANEL). Gabriel M. Giannini. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Report on recent experiments on highly ionized gas jets with energy content greater than chemically accelerated jets.

(A COMPARISON OF VARIOUS TYPES OF PROPULSION SYSTEMS, PRESENT AND FUTURE) (PROPULSION PANEL). Y. C. Lee. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Discussed the areas of research which are needed to obtain the goal of astronomical flight.

(A COMPARISON OF VARIOUS TYPES OF PROPULSION SYSTEMS, PRESENT AND FUTURE) (PROPULSION PANEL). A. P. Graff. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Propulsion systems for space travel.

(A COMPARISON OF VARIOUS TYPES OF PROPULSION SYSTEMS, PRESENT AND FUTURE) (PROPULSION PANEL). Robert A. Cornog. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Research and Convair. He presented some charts in which he pointed out the methods of oxidizing the ion rocket.

(A COMPARISON OF VARIOUS TYPES OF PROPULSION SYSTEMS, PRESENT AND FUTURE) (PROPULSION PANEL). Oliver E. Rogers. Astronautics Symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and Convair. Possibilities of using light weight turbo jet engines for the initial phase of boost of multiple stage rocket systems, and on the possibility of utilizing turbo jet propulsion systems after reentry into the earth's atmosphere

PROPULSION AND POWER SUPPLY (Other than conventional rocket) - Continued

for extending the gliding range for for the landing craft.

POSSIBLE STATES OF A TWO-GRAVITON SYSTEM. V. A. Zhirnov and Iu. M. Shirokov. Soviet Physics, JETP, v.3, no.6, Jan.1957, p.840-843. Eigenfunctions are obtained for the angular momentum operator of one and two gravitons. The states of a single graviton are separated, according to their parity, into quasielectric and quasimagnetic states. The possible states of a two-graviton system are investigated. The Clebsch-Gordan coefficients are calculated for $S = 3$ and $S = 4$.

ON THE EFFECT OF RADIO WAVES ON THE PROPERTIES OF PLASMA (IONOSPHERE). A. V. Gurevich. Soviet Physics, JETP, v.3, no.6, Jan.1957, p.895-904. A successive method is developed for determining the electron-velocity-distribution function in plasma in an alternating electric field and a constant magnetic field, assuming the collisions between the electrons and molecules or ions to be elastic. Expressions are derived and analyzed for the mean electron energies, for the conductivity and the dielectric constant of the plasma, and the effective number of electron collisions.

SMALL POWER PLANTS FOR SPACE APPLICATIONS. (TO BE PRESENTED AT IAS ANNUAL MEETING, Jan.27, 1957). Louis Rosenblum. NACA Preprint. (N-58941).

1956

POWER SOURCES FOR SPACE FLIGHT. Siegfried Fred Singer. Missiles and Rockets, Dec.1956, p.82-84. Discussion of various methods for space propulsion which include chemical batteries, a solar battery, a rechargeable fuel-cell battery, nuclear reactor power, and fusion power.

SOLAR POWER FOR SPACECRAFT. Krafft A. Ehricke. Missiles and Rockets, Nov. 1956. p.44-46. Discussion of a hydrogen-manufacturing space vehicle which used pressure-stabilized spherical reflectors for water-oxyhydrogen conversion.

ZUR FLUGMECHANIK DER PHOTONENRAKETEN (GERMAN). Eugen Sanger. (7th International Astronautical Congress, Rome, Sept. 1956). Astronautica Acta, no.2, 1957, p.89-99. Theoretical discussion of the possibility of flight at velocities approaching the speed of light, by means of photon rockets.

POWER SUPPLIES AND TELEMETRY FOR AN INSTRUMENTED ARTIFICIAL SATELLITE. PART 1 - ORBITAL CONSIDERATIONS. E. C. White. PART 2 - INSTRUMENTATION AND TELEMETRY. J. Foley. PART 3 - AVAILABILITY OF POWER. R. G. Wilkins. Journal of the British Interplanetary Society, v.15, no.71, July-Aug.1956. p.177-191. Considerations of various possible satellite orbits with preference given to the one that will provide the vehicle with the most sunlight for its solar batteries.

PROPULSION AND POWER SUPPLY (Other than conventional rocket) - Continued

PROGRESS IN SOLAR POWER. Harry Tabor. Scientific American, v.195, no.1, July 1956, p.97. The search for ways to tap the sun's energy has taken some promising new turns.

FLIGHT MECHANICS OF PHOTON ROCKETS. Eugen Sänger. Aero Digest, v.73, no.1, July,1956, p.68-70, 72-73. Astronautica Acta, v.3, no.2, 1957, p.89-99. Hypothetical rocket system exhaust mass of which attains velocity of light; consideration of relativity with reference to time and distance for interplanetary s space craft; predictions of time speed and fuel mass required for various destinations; theoretical conditions under which time span of one human life would be long enough for travel around total static universe. From paper at conference on Jet Propulsion at Freudenstast, and Report 5 of Research Inst. for Physics of Jet Propulsion, Stuttgart.

CONTROLLED FUSION RESEARCH - AN APPLICATION OF THE PHYSICS OF HIGH TEMPERATURE PLASMAS. Richard F. Post. Reviews of Modern Physics, v.28, no.3, July 1956, p.338-363. (N-58831)

SECOND ANNUAL REPORT OF THE DIRECTORATE OF THE INSTITUTE OF THE WORK OF THE RESEARCH INSTITUTE FOR PHYSICS OF JET PROPULSION, STUTTGART, AT THE 3RD REGULAR CONFERENCE OF THE MEMBERS ON JULY 20,1956. Eugen Sänger and Irene Sänger-Bredt. NACA Unpublished TM. Includes abstracts of Institute reports on booster rockets, ram jets, chemical liquid-fuel rockets, thermonuclear rockets and photon-jets for spacecraft, etc. (N-49902)

THERMONUCLEAR POWER...THE SEARCH FOR IDEAS. Nucleonics, v.14, no.2, Feb.1956, p.43-44. (CN-57733)

COMPONENTS FOR INSTRUMENTATION OF SATELLITES. (PRESENTED AT 10TH MEETING OF UPPER ATMOSPHERE ROCKET RESEARCH PANEL, UNIV.OF MICH., Jan.26-27,1956). H. K. Ziegler. Scientific uses of earth satellites, ed. by James A. Van Allen, 1956, p.55-67. (523.1 V26). The environmental conditions of satellite instrumentations are reviewed. Present and predictable availability of suitable chemical batteries, solar batteries, electron tubes, transistors, and frequency-control devices is discussed. Special attention is given to the comparison of power sources.

ATOMIC ENGINES. R. G. Perel'man. Rand Corp. RM-1922, p.57-61. Translation from Nauka i Zhizn', vol.23, no.1, Jan.1956, p.26-32. (CN-47550, pt.2)

THE ATOMIC AIRPLANE OF THE FUTURE. G. Nesterenko. Rand Corp. RM-1922, p.45-55. Translation from Kryl'ya Rodiny, no.1, Jan.1956, p.12-14. (CN-47550,pt.2)

ELECTROGRAVITICS SYSTEMS; AN EXAMINATION OF ELECTROSTATIC MOTION, DYNAMIC COUNTERBARY AND BARYCENTRIC CONTROL, PREPARED BY GRAVITY RESEARCH GROUP, AVIATION STUDIES (INTERNATIONAL) LIMITED. 1956.

PROPULSION AND POWER SUPPLY (Other than conventional rocket) - Continued

Aviation Studies (International) Ltd., London. Gravity Research Group Report GRG-013/56.

A NEW TYPE OF NUCLEAR POWER FOR SPACE FLIGHT. R. L. Carroll. American Rocket Society. Preprint 375-56, 1956. Theoretical investigation to develop a type of nuclear reaction which is the reverse of fusion and which, because it provides mass in motion with high velocities (25,000 mi./sec.), is naturally applicable to the problem of rocket propulsion for space travel. Includes calculation indicating the advantages of such a fuel over the present chemical fuels. It is shown that the reaction can be made self-sustaining as long as reacting material is present and that it can be confined within the walls of a solid material. The rate of reaction can then be controlled by the rate at which fuel is introduced.

ON THE APPLICATION OF SOLAR POWER IN SPACE FLIGHT. (PROBABLY READ AT 7TH INTERNATIONAL ASTRONAUTICAL CONGRESS, ROME, 1956). Krafft A. Ehricke. Convair. This paper investigates some aspects of reducing the terrestrial supply requirements of expendable material for space operations by utilizing hydrogen in high-specific impulse solar power drives, as well as in chemical propulsion systems. Particular attention is devoted to the flight mechanics of low-thrust powered flight paths, as they would apply to solar power drives. (CN-48574)

ON THE BRIDGING OF INTERSTELLAR DISTANCES. (UBER DIE UBERBRUCKING INTERSELLARER ENTFERNUNGEN) (IN GERMAN). W. Peschka. Astronautic Acta, v.2, no.4, 1956, p.191-200. Study which shows that distances up to 25 light-years, plus return voyage, may eventually be attainable by means of photon rockets.

THE SOLAR-POWERED SPACE SHIP. Krafft A. Ehricke. American Rocket Society Preprint 310-56,1956.

EXOTIC PROPULSION METHODS (OF A SATELLITE). A. John Gale. Taken from: Orbital and Satellite Vehicles, v.1 and v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

1955

ELECTRICAL PROPULSION SYSTEM FOR SPACE SHIPS WITH NUCLEAR POWER SOURCE. Ernst Stuhlinger. Journal of Astronautics, v.2, no.4, Winter 1955, p.149-152; Ibid., v.3, no.1, Spring 1956, p.11-14, no.2, Summer, p.33-36. System described produces thrust by expelling ions and electrons instead of combustion gases; equations derived for optimum mass ratio, power and driving voltage of ship with given payload, travel time and initial acceleration; nuclear reactor provides primary power for turbo-electric

generator; electric power then accelerates ions; caesium is best propellant.

NUCLEAR PROPULSION, AVIATIONS'S FUTURE. D. G. Samaras. Canadian Aeronautical Journal, v.1, no.6, Nov.1955, p.163-168. Future aviation subdivided into terrestrial, interplanetary or solar, and intragalactic aviation; terrestrial aviation achieved in 1903; interplanetary aviation may be attained by use of nuclear propulsion system; jet propulsion seems satisfactory; intragalactic aviation seems unlikely by known methods of propulsion, however, more advanced methods, such as field interaction propulsion may give satisfactory results.

CAN NUCLEAR ENERGY DRIVE INTERPLANETARY ROCKETS? C. Mannal. General Electric Review, v.58, no.3, May 1955, p.49-52. Survey of atomic power plants, including their operating temperatures, heat removal, control, shielding, and refueling in order to draw conclusions concerning applicability of such power plants to rockets; fundamentals of fusion, fission, and nuclear reactors; biological problems; nuclear waste disposal; fuel recovery; propulsion engine efficiency; interplanetary travel problems.

SOLAR ENERGY COULD DRIVE SPACESHIPS' ELECTROSTATIC POWERPLANT, I.R.E. HEARS. Philip J. Klass. Aviation Week, vol. 62, no.17, Apr. 25,1955, p.76-82. Discussion of I.R.E. Symposium on Space Station Problems, including Stuhlinger's electrostatic power plant, John R. Pierce's space station microwave mirror 22,000 miles high, and Singer's MOUSE.

IONIC AND NUCLEAR PROBLEMS OF ROCKET PROPULSION. Francis J. Murray. Paper given at Institute of Radio Engineers national convention, New York, Mar.21-24,1955, pt.10, p.35-36. Passenger carrying vehicles which can attain a satellite status around the earth, are usually thought of as rocket propelled. However a solution to the problem of air resistance by ionic controlled air flow may permit the development of high speed air vehicles. The energy requirements may also induce a change in the current developments in nuclear power. (N-39571)

1954

DESIGN METHOD FOR HIGH-ALTITUDE ROCKETS USING COMPRESSED GAS. (ENTWURFSVERFAHREN FUR HOHENRAKETEN MIT PREBGASFORDERUNG). (GERMAN TEXT). R. Engel. Fifth International Astronautical Congress, Innsbruck. Aug.5-7,1954, p.178-181. (N-46768)

POSSIBILITIES OF ELECTRICAL SPACE SHIP PROPULSION. Ernst Stuhlinger. International Astronautical Congress, Proceedings, 1954, p.100-119. IRE Nat. Convention, N.Y., Mar.21-24, 1955, pt.10, p.37-43. The present study was undertaken to find out whether an electrical propulsion system can be built so that it is competitive to a chemical propulsion

system in interplanetary space ships. A system is proposed in which a suitable propellant is vaporized and ionized at incandescent platinum te. Ions and electrons are accelerated and expelled at equal rates. Power is obtained from turbo-electric generators. Heat source is the sun. (N-39571)

1953

THE PROBLEM OF THERMO-ELECTRIC CURRENT GENERATION FOR EXTRA-TERRESTRIAL PROJECTS. H. Langenecker. Fourth International Astronautical Congress, held in Zurich, Aug.3-8,1953. Compared with diesel or turbine aggregates the efficiency of the thermopile is small but it possesses the advantage that there are no moving parts to wear out and hence maintenance problems are eased. It was suggested that solar energy or nuclear energy be used to heat the thermocouples. Attempts to improve the voltage generated were described and success was reported.

THE THEORY OF PHOTON ROCKETS. Eugen Sänger. Fourth International Astronautical Congress, held at Zurich, Aug.3-8,1953. The process of normal rockets is basically adiabatic. The released energy from the propellants is used to accelerate the whole of the propellant mass. There is the possibility of a diabatic system.

THE THERMODYNAMICS OF THE WORKING GASES FOR ATOMIC ROCKET. Irene Sänger-Bredt. Fourth International Astronautical Congress, Zurich, Aug.3-8,1953. Astronautical Acta, v.3, no.4, 1957, p.241-280. In nuclear-energy rockets the temperature of the working fluid can be set at any desired value and held constant. From this, by using a Mollier-diagram for hydrogen between pressure limits of 10^5 and 10^2 atmospheres certain conclusions were reached. All known thermochemical data was inccluded and the results were taken up to 10,000 deg. K.

THE PROBLEM OF COOLING ATOMIC ROCKETS USING THERMONUCLEAR REACTIONS. H. J. Kaeppeler. 4th International Astronautical Congress, held at Zurich, Aug.3-8, 1953. Film cooling due to Oberth, if appropriately modified, will be fully adequate even for the extreme temperatures which will appear in nuclear rockets. It was pointed out that even for relatively low pressures there appear very high temperatures with the enthalpies necessary for obtaining exhaust velocities higher than 10 to 15 km./sec.

THE ATOMIC HYDROGEN ROCKET. D. J. H. Wort. Journal of British Interplanetary Society, v.12, no.4, July 1953, p.167-172.

PROPULSION AND POWER SUPPLY (Other than conventional rocket) - Continued

1952

THE DYNAMIC WEIGHTLESS STATE AS THE SOLUTION OF THE ASTRONAUTICAL PROBLEM. (DIE DYNAMISCHE KONTRABARIE ALS LOSUNG DES ASTRONAUTISCHEN PROBLEMS). (GERMAN TEXT AND ENGLISH SUMMARY). B. Heim. Proceedings of the Third International Congress on Astronautics, Stuttgart, Sept.1-6,1952, p.181-187. The use of Heim's meso field theory for space vehicle propulsion makes possible high accelerations and velocities of about 10,000 km/sec.

A METHOD FOR COMPARING THE PERFORMANCE OF POWER PLANTS FOR VERTICAL FLIGHT. H. S. Tsien. Journal of the American Rocket Society, v.22, no.4, July-Aug.,1952, p.200-203, 212. Method proposed can be used to determine whether performance of rocket design can be improved by substituting for rocket motor different power plant, such as ramjet; calculations indicate that there are advantages in using ramjet provided power plant can be made to operate under rapid acceleration and at high altitudes.

FUNDAMENTAL BASIS OF POWER GENERATION IN SATELLITE VEHICLE. C. A. Cross. Journal of the British Interplanetary Society, v.11 no.3, May 1952, p.117-125. Construction of solar power generator claimed to be sound and practical.

ENERGY FROM THE HIGH ATMOSPHERE. N. C. Gerson. Journal of American Rocket Society, v.22, no.2, Mar.-Apr.1952, p.98.

1951

POWER SOURCES FOR ORBITAL ROCKETS. Lewis J. Grant, Jr. Chicago Rocket Society, Collection Tech. Repts., v.5, 1953, p.60. Journal of Space Flight, v.3, no.5, Nov. 1951, p.1.

INTERPLANETARY TRAVEL BETWEEN SATELLITE ORBITS. Lyman Spitzer, Jr. Second International Congress on Astronautics, London, Sept.3-8, 1951. J. of British Interplanetary Society, v.10, no.6, Nov.1951, p.249-257. Journal of the American Rocket Society, v.22, no.2, Mar.-Apr.1952, p.92-96. Discusses power sources, generation of electrical power, propulsion of ships, etc.

1949

FISSION PARTICLES AS ROCKET PROPELLANTS. Wayne Proell. Chicago Rocket Society, Collection Tech. Repts., v.3,1951, p.3. Journal of Space Flight, v.1, nos. 1 and 2, June and July 1949.

NOTE ON SHIELDING OF ATOMIC ROCKETS. L. R. Sheperd. Journal of the British Interplanetary Society, v.8, no.4, July 1949, p.149-157.

PROPULSION AND POWER SUPPLY (Other than conventional rocket) - Concluded

ROCKETS IN CIRCULAR ORBITS. Kenneth W. Gatland. British Interplanetary Soc. Jour., v.8, no.2, Mar.1949, p.52-59. Scheme for utilizing atomic rockets for space travel without contaminating areas of the earth. By using chemical propellants to assemble an atomic rocket in an orbit around the earth, the atomic propulsion vehicle can be fired safely.

1948

THE ATOMIC ROCKET, PARTS I, II, III and IV. L. R. Shepard and A. V. Cleaver. Journal of the British Interplanetary Society, v.7, no.4, July 1948, p.185. Journal of the British Interplanetary Society, v.7, no.6, Nov.1948, p.234. Journal of the British Interplanetary Society, v.8, no.1, Jan.1949, p.23. Journal of the British Interplanetary Society, v.8, no.2, Mar.1949, p.59.

HIGH ENERGY PARTICLES AS ROCKET FUELS. Norman J. Bowman. Chicago Rocket Society, Collection Tech. Repts., v.2,1951, p.47. Journal of Space Flight and Rocket News Letter, v.2, no.8, Mar.,1948.

1946

ATOMIC HYDROGEN - THE FUEL OF THE FUTURE. Louis C. Young. Journal of the American Rocket Society, vols.66-67, June-Sept.1946, p.35-37.

RANDOM THOUGHTS ON ATOMIC POWER, POSSIBILITIES OF NUCLEAR ENERGY FOR ROCKETS. William D. Monroe. Journal of the American Rocket Society, v.65, Mar.1946, p.28-29.

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TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.)

1958

BULLETIN FOR VISUAL OBSERVERS OF SATELLITES. (Moonwatch) Smithsonian Astrophysical Observatory, no.1, July 1956 to date. (CN-59409, no.1-no.8)

TELEMETERING FROM EXPLORER. Whitney Matthews. Electronic Industries, v.17, no.3, Mar.1958, p.58-59, 124. The American satellite instrumentation package is a marvel of miniaturization. The multichannel telemetering encoder described here operates on only 4 ma at 2.7 volts - weighs only 3.2 ounces. The satellite is sending a stream of information about space to technical centers throughout the world. The telemetering system has been widely publicized, and any country can record and decode the satellite signals. In preparing Explorer, one of the Vanguard telemetry packages was used, with some modifications. The article is a description of the basic Vanguard instrumentation package.

TRACKING PACKAGE FOR THE VANGUARD. Television and Radio Engr., Mar.1958.

DATA LINKS IN SPACE EXPLORATION, THEIR BASIS, APPLICATION, AND LIMITATIONS. Henry E. Prew. American Astronautical Society, annual meeting, New York, Jan.29-31,1958. This paper is mainly concerned with a presentation and discussion of a general method, with system design curves for establishing the system parameters for a data link for a given set of operational requirements using any of the radiation methods indicated above. The problem used as an example concerns the data link of a remotely controlled research vehicle capable of reaching Mars.

SOME OBSERVATIONS ON RUSSIAN ELECTRONIC TECHNOLOGY. Charles L. Rouault. American Astronautical Society, annual meeting, New York, Jan.29-31,1958. In the Spring of 1957, a group of American engineers attended the annual meeting of the Popov Society in Moscow and visited electronic manufacturing facilities in the Moscow-Leningrad area. From this visit and a study of the Sputnik articles appearing in "Radio" for June, July, and August, an estimate can be made of the electronic capabilities of the Russian industry. The rate of advance, and the current position indicate an overall capability of the Soviet Union generally equal to its requirements.

TELEVISION TELEMETER FOR MISSILE TEST PROGRAMS. Daniel Hochman and Jeremy P. Taylor. American Astronautical Soc., annual meeting, held in New York, Jan.29-31,1958. A study has been made on a monochrome television telemeter system to be used in testing and evaluating nonrecoverable supersonic missiles. The purpose of this system is to provide pictorial information on events such as stage separation, motor ignition and burning, vehicle yaw, pitch and

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

roll, and others, as they occur in actual flight. This paper describes a long-range medium-resolution system designed to supply video information from distances up to 1,000 miles.

R.F. PROPAGATION IN INTERPLANETARY COMMUNICATIONS. Allen M. Peterson. American Astronautical Society, Annual meeting, held in New York, Jan.29-31,1958.

A UNIVERSAL RADIO ASTRONOMY SYSTEM FOR RADIO TELESCOPES, SPACE VEHICLE TRACKING AND SCATTER PROPAGATION STUDIES. George J. Doundoulakis. Americal Astronautical Soc., annual meeting, held in New York, Jan.29-31, 1958. A universal adaptation of a radio telescope antenna reflector and pedestal mechanism is described which the General Bronze Corp. is manufacturing for the NBS. The design criteria of antenna systems will be covered for application to the problems of collecting radio astronomy data. The paper will include radiation patterns and servo control systems as well as an analysis of the overall environmental design conditions.

CONSIDERATIONS ABOUT VISIBILITY OF SATELLITES FOR THE UNAIDED EYE. Ingeborg Schmidt. American Astronautical Society, annual meeting, New York, Jan.29-31,1958. In order to draw conclusions about the visibility of satellites a suggestion is made to compute spaces of potential visibility for different positions of the sun below the horizon. Difficulties encountered are discussed.

THE SATELLITE TRACKING CAMERA. Joseph Nunn. (Presented at 26th annual meeting, IAS, Jan.27-30, 1958). Institute of the Aeronautical Sciences. Preprint 794. (CN-58723)

PROJECT VANGUARD REPORT NO.24. MINITRACK REPORT NO.4. THE SATELLITE TELEMETRY RECEIVER SYSTEM. V. R. Simas. Naval Research Lab. Rep.5065, Jan. 20, 1958. Scientific information from the artificial earth satellites will be transmitted to the telemetry systems located at each of the Minitrack stations. The telemetry receiver will amplify the received signals with the addition of as little receiver noise as possible and convert the information to a form which permits demodulation and subsequent analysis. The receiver is of the double-conversion type with crystal-controlled local oscillators. (CN-58509)

TRACKING SATELLITES BY RADIO. J. T. Mengel and Paul Herget. Scientific American, v.198, no.1, Jan.1958, p.23-29. The fastest, most reliable way to detect an artificial satellite and initially to determine its orbit is by radio. A far-flung system called Minitrack has been established for this purpose. (CN-58877)

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

1957

EARTH SATELLITE TELEMETRY CODING SYSTEM. R. W. Rochelle. Electrical Engineering, Dec.1957, p.1062-1065. Description of a simple three-channel system extended to a 48-channel system.

NEW CHART FOR WATCHERS OF THE SKIES. Allan C. Fisher, Jr. National Geographic Magazine, v.10, no.6, Dec.1957, p.811-816. As satellite flights turn our eyes toward the heavens your society maps the guideposts of the firmament. Special supplement map of the heavens included.

PROJECT VANGUARD REPT.23. MINITRACK REPT.3. RECEIVER SYSTEM. V. R. Simas and C. A. Bartholomew. Naval Research Lab. Rept.5055. Dec.6, 1957. (CN-58508)

ON THE TRACKING OF SATELLITES. Arnold Peterson. Gen. Radio Exp. Dec.1957, p.3-6. Discussion of a set of measurements similar to those which were applied to Sputnik I and II and of certain refinements in handling data used for path and time of transit predictions by the local Moon-Watch group.

TELEMETERING IN EARTH SATELLITES. Whitney Matthews. Electrical Engineering, v.76, Nov.1957, p.976-981. New instrumentation technique combining square hysteresis loop magnetic cores with switching transistors is discussed in description of magnetic telemetry encoding system.

TELEMETERING FOR INTERPLANETARY FLIGHT. E. H. Krause. ISA Journal, v.4, Oct.1957, p.478-480. Reliability; long distance telemetry; data processing; phenomena related to propagation; telemetering in atomic defense.

OPTICAL TRACKING OF THE IGY EARTH SATELLITE. J. Allen Hynek. Optical Society of America, 42nd annual meeting, Columbus, Oct.17-19,1957. The present status of the Earth Satellite Optical Tracking Program will be treated, with special emphasis on the performance testing of the unique Baker-Nunn Schmidt cameras designed especially for satellite tracking, and on the photographic and time-presentation techniques to be used in the tracking process.

EFFECT OF ANGULAR MOTION ON THE THRESHOLD FOR DETECTING AN EARTH SATELLITE. I. S. Gulledge, M. J. Koomen, D. M. Packer, and R. Tousey. Optical Society of America, 42nd annual meeting, Columbus, Oct.17-19, 1957. An artificial earth satellite of 20-inch diameter will appear as a star, no brighter than magnitude 5.4, moving at an angular velocity less than 1.3°/sec. The visibility of such a satellite has been calculated by Tousey on the basis of visual threshold data for a stationary point source of light.

SPACES OF POTENTIAL VISIBILITY OF ARTIFICIAL SATELLITES FOR THE UNAIDED EYE. Ingeborg Schmidt. (Presented at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957). American Rocket Society Paper 498-57. (CN-57905)

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

PREPARATION FOR VISUAL OBSERVATION OF ARTIFICIAL EARTH SATELLITES. A. T. Masevich. Paper given at 8th International Astronautical Congress, Barcelona, Oct.6-12, 1957. The equipment developed for visual observation of the satellites and the organization of the volunteer teams of observers are outlined. Both are very similar to those in the U.S.A.

OPTICAL AND VISUAL TRACKING OF ARTIFICIAL SATELLITES. Fred Lawrence Whipple and Joseph Allen Hynek. (Presented at 8th International Astronautical Congress, Barcelona, Spain, Oct.6-12,1957). American Rocket Society, 500-57. The program for optical tracking of the IGY and other artificial satellites consists of three distinct parts: The visual search and acquisition program, MOONWATCH: The photographic tracking program, of high precision; and a communications, computation and analysis center located at Cambridge, Massachusetts, at the Smithsonian Astrophysical Observatory. (CN-57903)

ORBIT ACCURACY AND RANGES FROM GROUND-BASED OPTICAL TRACKING. Fred Lawrence Whipple. Eighth International Astronautical Congress, Barcelona, Oct.6-12,1957. Angular errors in measuring the distances of space vehicles by triangulation from two points produce errors in the distance proportional to the square of the distance and the inverse length of the base line. With the earth's radius as a base line, the probable observational error leads to distance determinations that are too coarse for precise maneuvering of space vehicles even as close as the moon, the distance error being approximately 110 km.

EAR TO SKY. J. T. Mengel. Astronautics, v.2, no.3, Oct.1957, p.28-30, 48. Requirements of tracking system for satellite; description of radio phase comparison angle tracking system named Minitrack; how it works and how it will be used to prove earth satellite has been placed in orbit.

MICROLOCK. A TRACKING RECEIVER FOR SATELLITE COMMUNICATIONS. Henry L. Richter, Jr. Research and Engineering, v.3, Oct.1957, p.13-17. Describes a California radio club's tracking of the Russian satellite.

PROJECT VANGUARD REPORT NO.21. MINITRACK REPORT NO.2. THE MARK II MINITRACK SYSTEM. Roger L. Easton. Naval Research Lab. Rept. 5035, Sept.12,1957. Presents all the aspects of the design, construction, and calibration of the Mark II system for the serious-minded amateur desiring to carry out radio observations of the satellite. (CN-55809)

BALLISTIC INSTRUMENTATION FOR THE IGY ROCKET PROJECT AT FORT CHURCHHILL. Harold W. Zancanata. Ballistic Research Labs., Aberdeen

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

Ground, Memo.Rept.1094. Sept. 1957. The rocket range for the IGY has been instrumented with DOVAP, DOVAP telemetering, and ballistic cameras. The instrumentation and field operations are discussed. A pre-IGY test program for testing the rocket launching facilities and instrumentation was conducted in the fall of 1956. Six rockets (Aerobee and Nike-Cajun) were instrumented with ballistic instrumentation which performed satisfactorily on all rockets. Photographs showing instrumentation are included. (CN-57179)

MINITRACK SYSTEM DESIGN CRITERIA. J. T. Mengel. Electrical Engineering, Aug.1957, p.666-672. Examination of the operating principles of the radio phase-comparison angle-tracking system, and discussion of the appropriate design with reference to the severe weight and size limitations and altitude limits of the Vanguard satellite.

PROJECT VANGUARD REPORT NO.18, MINITRACT REPORT NO.1 - PHASE MEASUREMENT. C. A. Schroeder, C. H. Looney, Jr. and H. E. Carpenter, Jr. Naval Research Lab. Rep.4995, July 26, 1957. The "Minitrack" system for tracking an artificial earth satellite, which has been developed as a part of Proj. Vanguard, is described briefly, and the phase measurement portion of this system is described in detail. The actual measurements performed by Minitrack are phase comparisons of signals resulting from the illumination of the ground station antenna field by the satellite transmitter. (CN-54328)

TRACKING THE MAN-MADE SATELLITE. M. Gunther. Radio Ü Telev. News, v.58, July 1957, p.31-33. (Appears as abstract in Proceedings of the IRE, v.46, no.3, Mar.1958, p.680). An outline of the preparations for launching and observing the U. S. satellite, including the use of an electronic computer for calculating the orbit from observational data.

TELEMETERED DATA CHECKS VANGUARD FLIGHT. F. W. Phalen. Electronic Ind. and Tele-Tech, July 1957, p.40-41, 77. Discussion of test instrumentation, data channels, and transducers to measure and record fuel temperature, fuel pressures, and skin temperatures.

OBSERVATION OF RADIO SIGNALS FROM THE ARTIFICIAL SATELLITE AND THEIR SCIENTIFIC SIGNIFICANCE. A. Kazantsev. Translation from Radio, no.6, June 1957, p.17-19 (USSR). (CN-57069X)

VISIBILITY OF ARTIFICIAL SATELLITES OF THE PLANET EARTH. Ingeborg Schmidt. (Presented at 28th annual meeting of Aero Medical Assoc., Denver, Colo., May 8, 1957). Journal of Aviation Medicine, v.28, no.5, Oct.1957, p.435-446.

THE U. S. ARMY CORPS OF ENGINEERS SUPPORT OF VANGUARD AND THE IGY AND A DYNAMIC DISPLAY SYSTEM FOR PRESENTING SATELLITE TRACKING INFORMATION. C. M. Parkin, Jr., and Edward J. Madden. (Presented

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

at ARS Spring meeting, Washington, D.C., Apr.4-6,1957). American Rocket Society, Inc. Preprint 426-57. (CN-59395)

BELL SYSTEM TRANSISTORS FOR MAN-MADE MOON. Western Electric Co. Mar.1957.

OBSERVATIONS OF ARTIFICIAL SATELLITES - II. J. Humphries. Journal of the British Interplanetary Society, v.16, no.1, Jan.-Mar. 1957, p.57.

TRACKING TECHNIQUES. Max Fishman. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Comparison of various types of satellite tracking systems.

TRACKING AND COMMUNICATION FOR A MOON ROCKET. R. T. Gabler and H. R. O'Mara. (Astronautics Symposium, San Diego, Feb.18-20, 1957). Rand Corp. P-1021. This paper considers certain phases of the overall problem of sending an instrument package to the moon to telemeter scientific information. This paper is concerned specifically with tracking the vehicle after it is placed on a proper trajectory, and of telemetering information after it lands.

MICROLOCK SYSTEM. E. Rechtin. Astronautics symposium, held in San Diego, under sponsorship of Office of Scientific Res. and Convair, Feb.18-20,1957. The "Microlock" system is another way of tracking the Vanguard satellite. Design objectives are (1) range between 2,500 and 15,000 miles, (2) last for several months as far as duration of beacon is concerned, (3) provide 4 channels of useful telemetering information having a total bandwidth of the order of 1 cps.

RADIO ASTRONOMY. Arnold Shostak. Astronautics symposium, held in San Diego, under sponsorship of Office of Scientific Res. and Convair, Feb. 18-20,1957. To navigate in outer space and to communicate between earth and moon or between earth and isolated ships, it is desirable to know something about background radiating sources. There sources can then be avoided where they may disrupt communication systems or they can be used as navigation aids.

SURVEY OF COMMUNICATIONS PROBLEMS ASSOCIATED WITH SPACE TRAVEL. James A. Marsh. Astronautics symposium, held in San Diego, under sponsorship of Office of Scientific Res. and Convair, Feb.18-20,1957. Minimum communication system between a ship and a base.

RADIO TRACKING, ORBIT AND COMMUNICATION FOR THE EARTH SATELLITE. John P. Hagen. (IAS 25th annual meeting, New York, Jan.28-31,1957). Aeronautical Engineering Review, May 1957, pp.62-66. Discussion of the planned orbit and error compensation and description of the "Minitrack" system, the data to be transmitted from the satellite, and the in-flight calculations necessary

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

to keep track of the satellite and to predict future positions.

OPERATION MOONWATCH. Walter H. Haas. Spaceflight, v.1, no.2, Jan.1957, p.49-51.

THE BAKER-NUNN SATELLITE-TRACKING CAMERA. Karl G. Henize. Sky and Telescope, Jan.1957, p.108-111. Description of an optical system to track and continually photograph an earth satellite.

CONDITIONS OF VISIBILITY OF THE ARTIFICIAL SATELLITE. (CONDITIONS DE VISIBILITÉ DU SATELLITE ARTIFICIEL). Frantisék Link. Studia Geophysica et Geodaetica, v.1, no.1, 1957, p.114-123. (French text)

THE EXPLORATION OF SPACE BY RADIO. R. H. Brown and A. C. B. Lovell. Interplanetary Publishing Co., London (1957).

RADIO ASTRONOMY. H. J. van de Hulst. Cambridge Press, (1957).

PROJECT VANGUARD - EARTH SATELLITE VEHICLE PROGRAM. CHARACTERISTICS, TESTING, GUIDANCE, CONTROL AND TRACKING. Frederick I. Ordway, III. Astronautica Acta, v.3, no.1, 1957, p.67-86.

ARMY SUPPORT OF VANGUARD AND A DYNAMIC DISPLAY SYSTEM FOR PRESENTING SATELLITE TRACKING INFORMATION. Charles M. Parkin, Jr., and Edward J. Madden. Amer. Rocket Soc., Preprint 426-57.

1956

SPACE EXPLORATION: THE NEW CHALLENGE TO THE ELECTRONICS INDUSTRY. Henry E. Prew. Journal of Astronautics, Spring 1957, p.9-15. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.17-29. Discussion of the need for a two-way radio data link to help in the remote control of a space research vehicle and presentation of preliminary performance data for such a system. (N-58942)

RADIO TRACKING OF IGY SATELLITE: THE MARK II MINITRACK SYSTEM. Roger L. Easton. Journal of Astronautics, Summer 1957, p.31-32,39. Proceedings of the 3rd American Astronautical Society, Dec.6-7, 1956, p.53-58. A brief history of the preliminary design leading to the final specifications for the Vanguard satellite ratio tracking program is presented. The author discusses the design details of the Mark II Minitrack system, as established to encourage participation in the satellite tracking effort by the worldwide groups of amateur radio operators.

PROJECT MOONWATCH - VISUAL TRACKING OF IGY SATELLITES. Armand N. Spitz. Proceedings of 3rd American Astronautical Society, Dec.6-7,1956, p.169-177. The visual tracking program for Project Vanguard is outlined. A general description of the amateur visual tracking program, Project MOONWATCH, and the coordination of this world wide effort under the sponsorship of the Smithsonian Astrophysical Observatory is presented. (N-58942)

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

OBSERVATION OF ARTIFICIAL SATELLITES. J. Humphries. Journal of the British Interplanetary Society, v.15, no.6, Nov.-Dec. 1956, p.347.

MICROLOCK: A MINIMUM-WEIGHT RADIO INSTRUMENTATION SYSTEM FOR A SATELLITE. William F. Sampson, Henry L. Richter, Jr., and Robertson Stevens. Jet Propulsion Lab., Calif. Inst. of Tech. PR 20-308, Nov.14,1956. Design, construction, and laboratory testing of a satellite-tracking system are described.

THE THEORY OF NONLINEAR EFFECTS IN THE IONOSPHERE. S. A. Zhevakin and V. M. Fain. Soviet Physics, JETP, v.3, no.3, Oct. 1956, p.417-425. Nonlinear effects which arise in the propagation in the ionosphere of modulated and unmodulated electromagnetic waves of arbitrary amplitude have been computed with consideration of the earth's magnetic field.

OPTICAL PROBLEMS OF THE SATELLITE. R. Tousey. Seventh International Congress of the International Astronautical Federation, Rome, Italy, Sept.1956. Optical Society of America, Lake Placid, N.Y., Oct.1956.

INSTRUMENTATION FOR OBSERVATION OF THE IGY SATELLITES. Fred Lawrence Whipple and Joseph Allen Hynek. Proceedings of the Instrument Society of America, Symposium on the IGY, Sept.1956.

THE OPTICAL PROGRAM. Fred L. Whipple. USNC-IGY Rocketry and Satellite Programs, National Academy of Sciences, U. S. National Committee for the IGY, Sept.1956. (Compilation of five speeches presented at the CSAGI Barcelona meeting, Sept.1956).

INTERPLANETARY COMMUNICATIONS. J. A. Webb. Journal of Astronautics, v.3, no.2, Summer 1956, p.29-30,36. Interplanetary communication by radio is feasible and practical with existing radio techniques; centimeter wavelength microwave frequency spectrum is probably most practical band for interplanetary communications where portion of transmission path is in earth's atmosphere; earth satellite would be very valuable radio relay station for space communications.

THE RADIO SKY. John D. Kraus. Scientific American, v.195, no.1, July 1956, p.32. Radio waves from outer space give us a remarkable new panorama of the heavens.

SATELLITE COMMUNICATION PROBLEMS. Jorgen Jensen. American Rocket Society Paper 309-56. (Presented at semiannual meeting, American Rocket Society, Cleveland, June 18-20, 1956). This paper discusses some of the factors affecting the design of a satellite communication system. The three problem areas discussed are: Orbit mechanical considerations, the propagation medium, and the communication link itself. (CN-49366)

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

INSTRUMENTING UNMANNED SATELLITES. Herman E. Lagow. Jet Propulsion, v.26, no.6, June 1956, p.496-497. Discussion of problems encountered in instrumenting a satellite.

FEASIBILITY STUDY FOR MINIMUM-WEIGHT RATIO INSTRUMENTATION OF A SATELLITE. William F. Sampson. (Incl. App.A: Computation of satellite temperature. W. S. Shipley. App.B: Phase-steerable tracking antenna. P. D. Potter and Robertson Stevens. (Ordcit proj.) Jet Propulsion Lab., Calif. Inst. of Tech. Pub.48, 2nd ed., June 15,1956. The study was undertaken to determine the feasibility of including in a minimum-weight satellite sufficient radio instrumentation to allow detection of the vehicle and determination of its position. Data requirements have been examined, and expected environmental conditions have been evaluated. (CN-47470)

PHOTOGRAPHIC TRACKING OF AN EARTH SATELLITE. Clyde William Tombaugh and Bradford A. Smith. Physical Science Lab., New Mexico Coll. of A. and M.A., Apr.10, 1956. (CN-44332)

TELEMETERING AND PROPAGATION PROBLEMS OF PLACING THE EARTH SATELLITE IN ITS ORBIT. Daniel G. Mazur. (Presented at Symposium on U. S. Earth Satellite Program - Vanguard of Outer Space, held at IRE National Convention, New York, Mar.19-22,1956). Institute of Radio Engineers, Proceedings, v.44, no.6, June 1956, p.752-754. IRE Convention Record, pt.1,1956, p.108-111. Includes a discussion of signal propagation over extended ranges, the diversity of requirements for the test and mission phases, and the need for reliable light-weight equipment. (CN-45812, pt.1)

TRACKING THE EARTH SATELLITE, AND DATA TRANSMISSION BY RADIO. J. T. Mengel. (Presented at Symposium on U. S. Earth Satellite Program - Vanguard of Outer Space, held at IRE National Convention, New York, Mar.19-22,1956). Institute of Radio Engineers, Proceedings, v.44, no.6, June 1956, p.755-760. IRE Convention Record, pt.1, 1956, p.112-118. Description of the NRL developed Minitrack system which is independent of time, weather, or seeing conditions for acquisition and tracking of the satellite by radio techniques. A sub-miniature radio transmitter will be provided within the satellite to illuminate antennas at ground tracking stations. By phase-comparison techniques, these ground stations will measure and record the angular position of the satellite as it passes through the antenna beam. (CN-45812, pt.1)

A RESEARCH PROGRAM BASED ON THE OPTICAL TRACKING OF ARTIFICIAL EARTH SATELLITES. Fred Lawrence Whipple and Joseph Allen Hynek. (Presented at Symposium on U. S. Earth Satellite Program - Vanguard of Outer Space, held at IRE National Convention, New York, Mar.19-22, 1956). Institute of Radio Engineers,

TRACKING AND COMMUNICATION (Including data transmission, telementary, etc.) - Continued

Proceedings, v.44, no.6, June 1956, p.760-764. IRE Convention Record, pt.1, 1956, p.119-123. Discussion of the problems involved in early acquisition tracking, frequent orbit calculations, ephemeris predictions for the precise photographic tracking, the establishment and operation of 12 to 15 precision photographic stations over the earth, operation of a communication net, and both current and final analysis of the positional data for obtaining more precise geophysical results. (CN-45812, pt.1)

SYSTEMS DESIGN CONSIDERATIONS FOR SATELLITE INSTRUMENTATION. L. G. deBey. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.49-54. (523.1 V26)

POSSIBILITY OF VISUAL TRACKING OF A SATELLITE. Donald E. Hudson. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earch Satellites, edited by James A. Van Allen, 1956, p.39-43. (523.1 V26)

SATELLITE TRACKING BY ELECTRONIC OPTICAL INSTRUMENTATION. Harrison J. Merrill. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.29-38. (523.1 V26)

TIME AVAILABLE FOR THE OPTICAL OBSERVATION OF AN EARTH SATELLITE. J. B. Zirker, Fred Lawrence Whipple, and R. J. Davis. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27, 1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.23-28. (523.1 V26)

VISIBILITY OF EARTH SATELLITE. R. Tousey. Astronautical Acta, v.2, no.2, 1956, p.101-112. Conditions for naked eye and telescopic visual observation of white 21-in. diam. earth satellite are calculated using known values of sky brightness, solar illumination, and visual thresholds of eye. (N-59494)

THE VISUAL PROGRAMME FOR THE ARTIFICIAL SATELLITE PROGRAMME OF THE INTERNATIONAL GEOPHYSICAL YEAR. Fred Lawrence Whipple. International Astronautical Congress, 7th, 1956, Rome. The optical tracking programme consists of: (1) The use of twelve 20 in. Schmidt photographic cameras, (2) The visual observation programme involving volunteer observers around the world using simple optical aids for the early acquisition and the tracking of the later stages of the satellite's life, and (3) The professional astronomers' programme using specialized equipment already available in the astronomical observatories of the world. The amateur programme is called Project "MOONWATCH" to distinguish it from the precision photographic tracking, and the Smithsonian Astro-physical Observatory is issuing a regular publication - "Bulletin for Visual Observers of Satellites."

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

ARTIFICIAL SATELLITES OF THE MOON. R. W. Buchheim. International Astronautical Congress, 7th, Rome, 1956. The effective life transmitter is limited by the power-supply capacity, if batteries are used. It would be highly desirable to make the satellite optically observable, thus giving it effectively an infinite life. Mr. Buchheim showed that satellites of visual magnitudes 10 to 6 would be 132 to 832 feet in diameter and assuming the skin to be made of aluminum foil 0.0001 inch thick, the weights would be 79 pounds to 3,140 pounds.

INTERFEROMETERS IN RADIO ASTRONOMY. B. F. Burke and M. A. Tuve. Smithsonian Contributions to Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.31-36. (CN-53300, v.1,no.1)

A TECHNIQUE FOR INSTRUMENTING SUBGRAVITY FLIGHTS. Grover J. D. Schack and David G. Simons. Holloman Air Force Base (1956). Journal of Aviation Medicine, v.28, no.6, Dec.1957, p.576-582. The equipment designed to instrument subgravity flights is uncomplicated and has the advantages of light weight and compactability. The complete package weighs less than 15 pounds and can be fitted easily into the observers' compartment of the F-94C aircraft. (CN-55624)

1955

SATELLITE VEHICLE FOR COMMUNICATION AND NAVIGATION. H. E. Canney, Jr. and F. I. Ordway, III. Aero Digest, v.71, no.6, Dec.1955, p.40, 42, 44, 46. Problem of ground-to-satellite communications depends on characteristics of satellites, their orbits, radio frequencies used and noise conditions.

RADIO EXPLORATION OF SPACE. R. C. Jennison. Journal of the British Interplanetary Society, v.14, no.6, Nov.-Dec.1955, p.307-312; discussion, p.312-314. Principles and applications of radio astronomy; various types of radio telescope in use; detection of meteor activity, aurora, and moon by radar techniques; various aspects of radio astronomy associated with emission of radio noise.

ROCKETS AND RADIO. C. M. Minnis. British Communications and Electronics, v.2, no.11, Nov.,1955, p.72-73. Instrumentation problems incidental to projects connected with flight of rockets and satellites in upper atmosphere and extent to which radio and radar techniques will play important roles both in telemetering of information and in measurement of ionospheric propagation; main features of typical airborne telemetering equipment and associated ground equipment.

RADIO TELESCOPES. John D. Kraus. Scientific American, v.192, no.3, Mar.1955, p.36-43.

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

ORBITAL RADIO RELAYS. J. R. Pierce. (Paper given at Institute of Radio Engineers national convention, New York, Mar.21-24,1955, pt.10, p.44.) Jet Propulsion, v.25, no.4, April 1955, p.153-157. (N-39571)

TELEMETRY IN THE DEVELOPMENT OF SPACE FLIGHT. Charles E. Ruckstuhl, Jr. Paper given at Institute of Radio Engineers National Convention, New York, Mar.21-24,1955, pt.10, p.45-48. The purpose of this paper is to explore what is available and what is likely to be available for the purpose of telemetering various quantities of data from vehicles operating in outer space.

INTERPLANETARY COMMUNICATIONS. J. R. Pierce. (Lecture to American Astronautical Society, Mar.16, 1955). Journal of Astronautics, v.2, 1955, p.75.

1954

DETECTION AND LOCATION OF THE FLIGHT CHARACTERISTICS OF ROCKETS AND MISSILES. (RILEVAMENTO E RIVELAMENTO DELLE CARATTERISTICHE DI VOLO DEI RAZZI E MISSILI). C. E. Cremona. 5th International Astronautical Congress, Innsbruck, Aug.5-7,1954, p.291-307. (Italian text). (N-46768)

1953

RADIO TELEMETRY. C. I. Cummings and A. W. Newberry. Journal of American Rocket Society, v.23, no.3, May-June, 1953, p.141-145. This article attempts to familiarize readers of the Journal with significant features of the more generally used telemetry systems, trends which hold possibilities for the future, and an indication of some of the unsolved instrumentation requirements which telemetering will some day be able to answer. A brief reference list, which will lead the reader to a large bibliography of telemetering material is included.

1952

MINIATURE AIRBORNE TELEMETERING SYSTEM. H. M. Hill, Jr. Tele-Tech., v.11, no.12, Dec.1952, p.68-72, 84, 86, 90, 94, 96.

PROBLEMS OF HIGH-FREQUENCY TECHNOLOGY IN SPACE FLIGHT. (UBER EINIGE HOCHFREQUENZTECHNISCHE PROBLEME DER WELTRAUMFAHRT). R. Merten. Proceedings of the Third International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.239-244. (German text and English summary.) The following three problems for the artificial satellite in an orbit about the earth are discussed: 1. How does the number of transmitting stations on the earth depend on the angle of inclination of the orbit against the equatorial plane and on the number of orbital revolutions n, if continuous communication between the earth and the artificial satellite is to be maintained? 2. How is the time T_F, which is at the disposal of one transmitter station on the earth for communication with the artificial satellite, influenced by the type of orbit? 3. What is

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Continued

the connection between the velocity v_m of the missile or vehicle to be oriented and the time T_F at the disposal for the duration of this orientation?

RADIOASTRONOMY AT JODRELL BANK. Siegfried Fred Singer. University of Manchester, Apr.4,1952. Office of Naval Research, London. Tech.Rept.ONRL-24-52. (N-16008)

RADIO COMMUNICATION ACROSS SPACE-SHIP-TO-SHIP AND SHIP-TO-PLANET. G. O. Smith. Journal of British Interplanetary Society, v.12, 1953, p.13. Proceedings of Second Symposium on Space Travel, New York, 1952.

RADIO ASTRONOMY. A. C. B. Lovell and J. A. Clegg. John Wiley and Sons, 1952.

1951

OPTIMUM ORBIT OF A SPACE STATION FOR RADAR TRACKING. R. Merten. Second International Congress on Astronautics, London, 1951. Symposium on Satellite Vehicles. Summary in Brit. Interplanetary Soc. Jour. v.10, no.6, Nov.1951, p.303. Suggests use of radar tracking or Doppler method for determining position of an orbital rocket both in ascending and orbital stages.

ESTABLISHING CONTACT BETWEEN ORBITING VEHICLES. Ralph Andrews Smith. Second International Congress on Astronautics, held in London, 1951, Symposium on Satellite Vehicles. British Interplanetary Society, Journal, v.10, no.6, Nov.1951, p.295-299. Discusses military use of contact between orbiting vehicles as well as fuel transfer points.

HIGH FREQUENCY TECHNIQUE AND SPACE FLIGHT. (HOCHFREQUENZTECHNIK UND WELTRAUMFAHRT). R. Merton, editor. (Paper delivered at 4th annual meeting of Gesellschaft für Weltraumforschung). Germany, 1951.

1950

EVALUATION OF ELECTRONIC SYSTEMS FOR THE DETERMINATION OF A MISSILE TRAJECTORY. Paul H. Reedy and William Hayward Pickering. Jet Propulsion Lab., Calif. Inst. of Tech. Progress Rept.18-2, Jan.18, 1950. This study report has been carried out in an attempt to evaluate current electronic systems as applied to the determination of missile trajectories. Pulse, CW, and combination systems have been compared as to intrinsic accuracy. In particular, it is believed that the S/N considerations of Section II merit special note, inasmuch as the relationship between accuracy and S/N appears to have received scant attention in the past. (N-3537)

1948

SUR L'AVANCE DU PÉRIGÉE DANS L'ORBITE DES SATELLITES ARTIFICELS DE LA TERRE. Ernest Esclangon. Académie des Sciences, Paris, Comptes Rendus, v.226, no.1, Jan.5,1948,

TRACKING AND COMMUNICATION (Including data transmission, telemetry, etc.) - Concluded

p.23-25. Discusses the difficulties involved in the observation of artificial satellites with radar.

ELECTRONICS AND SPACE FLIGHT. Arthur Charles Clark. Journal of the British Interplanetary Society, v.7, 1948, p.49-69.

1946

CONTRAST THRESHOLDS OF THE HUMAN EYE. H. Richard Blackwell. Journal of the Optical Society of American, v.36, no.11, Nov.1946, p.624-643. Experimental data are presented representing approximately 450,000 responses made by trained observers under laboratory conditions. Contrast thresholds are presented for stimuli brighter and darker than their background, and for two values of stimulus exposure. In each case, wide variations were studied in the parameters; stimulus contrast, stimulus area, and adaptation brightness.

VISUAL THRESHOLDS OF STEADY POINT SOURCES OF LIGHT IN FIELDS OF BRIGHTNESS FROM DARK TO DAYLIGHT. H. A. Knoll, R. Tousey, and E. O. Hulburt. Journal of the Optical Society of America, v.36, no.8, Aug.1946, p.480-482.

HUMAN AND SPACE MEDICAL PROBLEMS

1958

SORTIE INTO SPACE; THE NADC STORY. Naval Aviation News, Mar.1958, p.1-5. Description of Navy full pressure suit.

AVIATION MEDICINE ON THE THRESHOLD OF SPACE; SIGNIFICANT EVENTS OF THE PAST YEAR. Paul A. Campbell. Air Force Office of Scientific Research, Wash.,D.C. Aviation Medicine, v.29, no.3, Mar.1958, p.232, abstract. The past year has been marked by a series of events, a rapid accumulation of knowledge, and an outpouring of popular interest which, within the foreseeable future, will enable man to cross the threshold of space. This paper attempts to fit the bits and pieces of the accumulation of the past year together to show a pattern demonstrating where aviation medicine stands today in relation to the art.

FIVE DAYS ALOFT; RESEARCH IN HUMAN TRAVEL ON THE ENDLESS FRONTIER OF TIME. Charles A. Dempsey, Franklin D. Van Wart, Leonard Eisen, John G. Roth, Nina K. Morrison, Charles Myers. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31,1958. This paper is devoted to havitation research, which investigates diverse parameters of protracted advanced human travel.

SYNTHESIS OF HUMAN-AUTOMATIC CONTROL SYSTEMS FOR HIGH-PERFORMANCE VEHICLES. William L. Morris, and Richard C. Kaehler. American Astronautical Society, Annual meeting, held in New York, Jan.29-31,1958. This paper gives a summary of tests conducted at North American Aviation, Inc. utilizing analogical computer simulation methods and simulation by specially equipped aircraft in order to attain optimum integration of human pilots with automatic control systems for high-performance vehicles. Discussion includes a description of missile systems, simulation methods and equipment, test procedures, results, and applications to space systems.

THE SELECTION AND TRAINING OF A BIO-SATELLITE CREW. E. W. Conover, E. G. Aiken, and C. M. Whitlock. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31,1958. This paper describes the sort of selection and training program which will be required if these "factors of the individual" are to act in the direction of increasing rather than decreasing the venture's probability of success. For the purpose of this presentation it is assumed that the crew will be restricted to one person and the length of the flight to under ten days.

DESIGN OF AN ALGAL CULTURE CHAMBER ADAPTABLE TO A SPACE SHIP CABIN. James G. Gaume. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31,1958. A design is proposed for an algal

culture chamber suitable for adaption to a space-ship cabin, and intended as a component of a complete photosynthetic exchange capable of effecting the balance of a sealed ecological system. Such a system would become necessary in manned space operations of a prolonged nature. Three main objectives must be met in the operation of the system: (1) gas exchange, (2) waste re-utilization, and (3) food production.

ORIENTATION OF RESEARCH NEEDS ASSOCIATED WITH ENVIRONMENT OF CLOSED SPACES. William T. Ingram. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31,1958. A discussion of CO_2O_2 conversion, treatment of bodily wastes, recovery of usable water from contained air, urine, and other sources, removal of pollutants from contained air, purification or disposal of various liquid wastes is offered here.

SPACE CABIN DESIGN. Alfred M. Mayo. American Astronautical Society, Annual meeting, New York, Jan.29-31,1958.

PROJECT SKYBALL: A PROPOSED BASIC TRAINER FOR SPACE FLIGHT. Norman V. Petersen. American Astronautical Society, Annual meeting, New York, Jan.29-31,1958. Author discusses the need for a U.S. Space Training Facility, and in greater detail, presents a new proposal for the development of a low-cost, safe, manned rocket-powered capsule system for primary satellite-training missions.

RETURNING ALIVE FROM SPACE. Fred R. Riddell and R. W. Detra. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31, 1958. Major problems in returning a man alive from space are encountered in re-entering the earth's atmosphere at very high velocities. During re-entry the basic physiological problem is to keep the deceleration within tolerable human limits while the principal aerodynamic problem is to prevent the vehicle from being destroyed by the high rate of heat transfer.

ISOLATION AND CONFINEMENT IN SPACE FLIGHT. G. E. Ruff, E. Z. Levy and V. H. Thaler. American Astronautical Society, annual meeting, New York, Jan.29-31,1958. Studies are discussed which suggest that stresses arising from sensory changes, isolation, and confinement may disrupt human performance. Results indicate wide variations in response by the individuals tested and permit tentative conclusions regarding methods of crew selection.

IONIZATION DOSAGE FROM X- AND BETA RAYS IN FLIGHT THROUGH AURORAL DISPLAYS. Hermann J. Schaefer. American Astronautical Society, Annual meeting, held in New York, Jan.29-31,1958. The earth's magnetic field exerts a deflection influence on charged cosmic-ray primaries prohibiting low-energy particles from reaching the planet's atmosphere. Therefore, one would expect to encounter low-energy particles only in deeper regions of the air ocean, after they have been

slowed down in interaction processes, or at any altitude around the geomagnetic poles, since charged particles moving in the lines of magnetic force are not deflected.

ADVANCES IN ASTROBIOLOGY. Hubertus O. Strughold. American Astronautical Soc., Annual meeting, held in New York, Jan.29-31, 1958. Astrobiology deals essentially with the problem of the possibility of indigenous life on other planets. This paper discusses these possibilities in our solar system based on a zonal ecological approach, and finally concentrates upon the planet Mars by reviewing recent spectrographic studies and other studies concerning the behavior of terrestrial microorganisms under simulated Martian conditions.

THE ENVIRONMENT OF SPACE IN HUMAN FLIGHT. Charles A. Berry. (Presented at 26th annual meeting, IAS, Jan.27-30,1958). Institute of the Aeronautical Sciences. Preprint 796. (CN-58722)

CYBERNETICS IN HUMAN FLIGHT. George T. Hauty. (Presented at 26th annual meeting, IAS, Jan.27-30,1958). Institute of the Aeronautical Sciences. Preprint 798. In space travel, the human operator will certainly be denied much of the sensory experience to which he is normally accustomed. Coupled with this is the possibility that the functions required of this component will be highly repetious in character. Unless these inherent dangers are recognized and counteracted by appropriate measures, the human component could become the most aberrant component of the entire system. (CN-58734)

SUPERSONIC AND HYPERSONIC HUMAN FLIGHT. J. E. Ward, S. J. Gerathewohl and G. R. Steinkamp. (Presented at 26th annual meeting, IAS, Jan.27-30,1958). Institute of the Aeronautical Sciences. Preprint 797. (CN-58732)

INTERRELATIONS OF SPACE MEDICINE WITH OTHER FIELDS OF SCIENCE. Hubertus O. Strughold. (Presented at 26th annual meeting, IAS, Jan.27-30,1958). Institute of the Aeronautical Sciences. Preprint 819. (CN-58731)

CONDITIONS ON THE MOON WITH WHICH THE FIRST LANDING CREW WILL CONTEND. Gilbert Fielder. Spaceflight, v.1, no.6, Jan.,1958, p.216-219.

MEDICAL AND BIOLOGICAL PROBLEMS. A. E. Slater. In Space Research and Exploration, edited by D. R. Bates. 1958. (629.1388 B31).

1957

WEIGHTLESSNESS. Siegfried J. Gerathewohl. Journal of Astronautics, Nov.1957, p.32-34,74,75. Discussion of the physical principles of weightlessness, how it is achieved in an aircraft, and an account of human reactions to this phenomena.

HUMAN AND SPACE MEDICAL PROBLEMS - Continued

PRODUCING THE WEIGHTLESS STATE IN JET AIRCRAFT. Seigfried J. Gerathewohl and others. (Paper given at the Eighth International Astronautical Congress, Barcelona, Oct.6-12,1957). American Rocket Society, Inc. 503-57. Gives the simple mathematical functions used for computing the most interesting and important characteristics of parabolic flight maneuvers used to produce the weightless or "agravic" state. The results of calculations based upon certain flying characteristics of the Lockheed T-33A F-94C Starfire, and F-104B aircraft in subsonic and transonic flight are in good agreement with the data obtained for the first two aircraft types during actual zero-gravity maneuvers.

APPLICATIONS OF SATELLORB (SATELLITE SIMULATING OBSERVATION AND RESEARCH BALLOON). David G. Simons. (Paper given at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957). American Rocket Society. Paper 502-57. A one-man Satellorb capsule designed for a 24 hr. flight at 30 km. altitude weighs between 700 and 1,000 lb. and permits study of human reactions under conditions of remote isolation almost equivalent biologically to those of space itself. A multi-man capsule would weigh between 1,200 and 2,000 lb. and would enable a full-time scientific observer to be carried. (CN-57902)

INSTRUMENTATION OF HUMAN ENDURANCE. Sidney R. Smith. Institute of Radic Engineers, Transactions on Instrumentation, v.I-6, Sept.1957, p.163-171. Conclusions from the planning of an experiment which may isolate and measure the effects of extreme confinement upon an aircraft crew of five men. Feasibility of monitoring and recording conduct, performance, and autonomic-response variables in sufficient number and with sufficient accuracy to provide useful new data. (TK1 In6.6i Vis.)

PROBLEMS OF RESPIRATORY METABOLISM IN SEALED CABINS. Hans G. Clamman. Symposium on high altitude and satellite rockets. Held at College of Aeronautics, Cranfield, approx. July 1957. Organized by British Interplanetary Society, College of Aeronautics and Royal Aeronautical Society.

RADIOBIOLOGISCHE PROBLEME DER RAUMFAHRT. (GERMAN) E. H. Graul. Raketentech and Raumfahrtforsch., July 1957, pp.40-47. Study of "radio-biological" problems involved in space travel.

PSYCHO-PHYSIOLOGICAL HAZARDS OF SATELLITE FLIGHT. J. P. Henry. Symposium on high altitude and satellite rockets. Held at College of Aeronautics, Cranfield, approx. July 1957. Organized by Brit. Interplanetary Soc., College of Aeronautics and Royal Aeronautical Soc. Mental breakdown has followed sensory deprivation such as might have its parallel in weightlessness. When information was denied the brain from sensory and tactile

sources the patient may sleep or hallucinate in response to stimuli from an inner world of the brain.

THE LABYRINTHINE POSTURE REFLEX (RIGHTING REFLEX) IN THE CAT DURING WEIGHTLESSNESS. Siegfried J. Gerathewohl and Herbert D. Stallings. (Presented at 28th annual meeting of Aero Medical Assoc., Denver, Colo., May 8, 1957). Journal of Aviation Medicine, v.28, no.4, Aug.1957, p.345-355.

AERO MEDICAL ASSOCIATION, 28th Annual Meeting, held in Denver, May 8,1957 - Space travel: A symposium.

ONE TEST PILOT'S VIEWPOINT OF EXTRA-ATMOSPHERIC FLIGHT. A. Scott Crossfield. North American Aviation, Inc. TFD-57-293. May 6-8,1957. (CN-54138)

THE PROBLEM OF WEIGHTLESSNESS. Alan E. Slater. Spaceflight, v.1, no.3, Apr.1957, p.109-113.

PSYCHOLOGICAL CONSEQUENCES OF SPACE TRAVEL. E. Jack Wilcox. Journal of the British Interplanetary Society, v.16, no.1, Jan.-Mar.1957, p.7.

SEVERAL TECHNIQUES FOR CONDUCTING SPACE BIOLOGY. David G. Simons. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and Convair. Experiments were conducted on balloon flights, illustrating procedures employed to expose experimental animals to primary cosmic radiation. The problems encountered in providing a sealed cabin atmosphere for the animal capsules for a period up to 30 hours. Aspects of the re-entry problem in relation to human factors.

HUMAN LOGISTICS IN AIR TRAVEL. Paul A. Campbell. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and Convair. So far as human requirements are concerned, if space flight is to be achieved, there must be a general rule that energy, protection, etc. must be supplied at minimum weight, in mimimum volume, and then if consumed, utilized at the lowest consumption rate consistent with the job needs.

FATIGUE, CONFINEMENT AND PROFICIENCY DECREMENT. George T. Hauty. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and Convair. Study designed to appraise certain effects of dextroamphetamine (a drug which counteracts fatigue). Subjects were trained on a task which consisted of monitoring several simulated aircraft indicators and upon the detection of departures from null, executing corrective action.

THE CONCEPT OF AN INHABITED SPACE SIMULATED LABORATORY. Richard Roche. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Such a laboratory is absolutely essential for an understanding of the operation of equipment in space and the building, construction and testing of equipment to go there.

HUMAN AND SPACE MEDICAL PROBLEMS - Continued

APPRAISAL OF COSMIC RAY HAZARDS IN EXTRA-ATMOSPHERIC FLIGHT. Hermann J. Schaefer. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Res. and Convair. Cosmic ray primaries have been shown to produce severe damage on the cellular level. How far this local injury will produce a general reaction in organism depends on the frequency of hits. Fairly accurate data on this frequency are available only for balloon altitudes. For the fully extra-atmospheric region, not even informed guesses are possible.

SELECTION AND TRAINING OF PERSONNEL FOR SPACE FLIGHT. David H. Beyer and Saul B. Sells. Journal of Aviation Medicine, v.28, no.1, Feb.1957, p.1-6.

NEURO-ENDOCRINE FACTORS ESSENTIAL FOR SURVIVAL IN SPACE. William R. Brewster and others. American Rocket Society Preprint 389-57 (1957).

PHYSIOLOGICAL AND PHYCHOLOGICAL TOLERANCE TO WEIGHTLESSNESS. Siegfried J. Gerathewohl. American Rocket Society Preprint 390-57, 1957.

1956

ACCELERATIVE FORCES ASSOCIATED WITH LEAVING AND REENTERING THE EARTH'S GRAVITATIONAL FIELD. Rufus R. Hessberg, Jr. Journal of Astronautics, Spring 1957, p.6-8. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.95-100. Discussion of human experiments under acceleration forces and presentation of theoretical calculations for these forces. (N-58942)

MECHANORECEPTORS, GRAVIRECEPTORS. Hubertus O. Strughold. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.101-106. Attention is given to the sensing devices called mechanoreceptors or gravireceptors, located in the skin, in the skeletal muscles and in the connective tissue, which aid man's perception of the position and movement of his limbs and of the whole body. The anatomy of these mechanoreceptors, their physiological function under normal gravitational and zero-gravity conditions are discussed.

STUDY OF THE VITAL ACTIVITY OF ANIMALS DURING ROCKET FLIGHTS INTO THE UPPER ATMOSPHERE. A. V. Pokrovskii. (Presented at Congress International des Fusées et Engins Guides, Paris, Dec.3-8,1956.) Rand Corp. RM-1922, p.163-172. For the complete text in French see Etudes Soviétiques, Paris, no.106, Jan.1957, p.65-70. (CN-47550,pt.2)

ENVIRONMENTAL PROBLEMS CONNECTED WITH SPACE SHIP OCCUPANCY. William T. Ingram. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.117-120. Handling human wastes, perspiration and respiration end products, provision for personal hygiene, clothes cleaning, safe space atmosphere, food preparation and potable drinking

water are discussed. Views concerning biological resources to retain oxygen-CO_2 balance, thermal cracking of complex organic materials, and physical and chemical aids to the removal of toxic substances from both air and water supply are suggested. (N-58942)

PLANTS AS A MEANS OF BALANCING A CLOSED ECOLOGICAL SYSTEM. James G. Gaume. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.107-116. A discussion of the theoretical possibilities of the use of green algae in effecting a symbiotic relationship between man and plant in closed systems such as a manned satellite or spaceship cabin. (N-58942)

LONG TERM HUMAN CONFINEMENT IN SPACE EQUIVALENT VEHICLES. Charles A. Dempsey, Franklin D. Van Wart, John H. Duddy and Jack Hockenberry. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.89-93, Journal of Astronautics, v.4, no.3, Autumn 1957, p.52-59. Controlled experiments conducted by WADC; results of first project in 1954 concerned with confinement of subjects in small fighter-type cockpits for 24 and 56 hours, respectively; current project deals with group confinement problems associated 124 hour space equivalent flights; techniques to be used in physiologic and psychologic evaluations. (N-58942)

MEDICAL PROBLEMS INVOLVED IN ORBITAL SPACE FLIGHT. Hubertus O. Strughold. Jet Propulsion, v.26, no.9, Sept. 1956, p.745-748,756,788. American Rocket Society. Paper 242-55. Discussion of some of the most important medical problems involved in space operations such as weightlessness, the optical situation, physiological day-night cycling is discussed in an environment where there is no natural day or night and some problems involved in human engineering of the space cabin concerning pressurization, supply of oxygen, removal of carbon dioxide, photosynthetic gas exchange and sudden decompression of the cabin. Bibliography.

BIOLOGICAL PROBLEMS OF INTERPLANETARY FLIGHTS. I. S. Balakhovskii and V. B. Malkin. Rand Corp. RM-1922, p.81-96. Translation from Priroda, vol.45, no.8, Aug. 1956, p.15-21. (CN-47550,pt.2)

PRESENT STATUS OF SPACE MEDICINE. F. A. Hitchcock. Journal of Astronautics, v.3, no.2, Summer 1956, p.41-42,51-52. In addition to suitable environment in cabin of space ship, there are certain unavoidable physiologic stresses which must be tolerated, including accelerative forces incident to take-off from earth, effects of gravity free state, hazards involved in exposure to cosmic radiation and cosmic radiation and possibility of collision between space ship and meteorite; from physiologic and medical standpoints there seems to be no insuperable obstacles to space flight.

HUMAN AND SPACE MEDICAL PROBLEMS - Continued

OXYGEN BELT IN PLANETARY SYSTEM. Hubertus O. Strughold. Astronautics, v.3, no.2, Summer 1956, p.27-28,52. Discussion relates to possibility of life on other planets; factors in present day atmospheres of other planets; evolution of protoatmospheres of earth to present day atmosphere; reasons for oxidized atmospheres on planets from Mars to Venus.

AIR FOR SPACE SHIP. R. P. Haviland. Journal of Astronautics, v.3, no.2, Summer 1956, p.31-32,48. Various inert gases considered as possible substitutes for nitrogen in air system for space ships; use of helium, argon, krypton and neon; it appears that none of possibilities are superior in all respects to nitrogen; it is probable that space ship operations will utilize normal nitrogen-oxygen air system.

CLIMATIZATION OF ANIMAL CAPSULES DURING UPPER STRATOSPHERE BALLOON FLIGHTS. David G. Simons and Druey B. Parks. Jet Propulsion, v.26, no.7, pt.1, July 1956, p.565-568. Experiments requiring exposure of animals to primary cosmic radiation at altitudes about 90,000 ft. on 24 hr. balloon flights have led to the development of environmental control techniques.

RELATIVITY AND SPACE TRAVEL. Herbert Dingle and W. M. McCrea. Nature, v.177, no.4513, Apr.28, 1956, p.782-785 (discussion in Nature, v.178, no.4535, Sept.29, 1956, p.680-682). First author takes to task those who invoke so-called "relativistic contraction of time" as basis for assumption that space travelers would age less rapidly than persons on earth or that time would pass more rapidly on earth than on space ship; second author criticizes statements of first author and holds that exposition of relativity theory by him is "wrong"; rebuttal, by first author, further disagrees with claims of second author on interpretation of A. Einstein.

ENVIRONMENTAL CONSIDERATIONS OF SPACE TRAVEL FROM THE ENGINEERING VIEWPOINT. Alfred M. Mayo. (Presented at 27th annual meeting of Aero Medical Assoc., Chicago, Apr.16,1956). Journal of Aviation Medicine, v.27, no.5, Oct.,1956, p.379-389.

SENSOMOTOR PERFORMANCE DURING WEIGHTLESSNESS; EYE-HAND COORDINATION. Siegfried J. Gerathewohl, Hubertus Strughold and Herbert D. Stallings. (Presented at 27th annual meeting of Aero Medical Assoc., Chicago, Apr.16,1956). Journal of Aviation Medicine, v.28, no.1, Feb.1957, p.7-12. Subgravity and zerogravity states were produced by flying dives at high altitudes in a T-33A type aircraft. The results of a simple aiming test obtained from seven subjects show that eye-hand coordination is moderately disturbed by increased or decreased acceleration. The subjects already adjusted to the situation during the first six exposures to weightlessness.

HUMAN AND SPACE MEDICAL PROBLEMS - Continued

THE ATMOSPHERE OF A SPACESHIP. Lewis J. Grant, Jr. Journal of Space Flight, Apr.1956, p.1-6. Evaluation of various gas mixtures in terms of passenger comfort and health, weight, inflammability, economic feasibility, and the experimental problems to be encountered.

GRAVITY CHANGES IN AIRCRAFT AND SHIPS. Harald J. A. von Beckh. Journal of the British Interplanetary Society, v.15, no.2, Mar.-Apr.1956, p.73-81. The experiments described demonstrate that the senses of equilibrium, vision and kinesthesis provide the means of orientation and coordination under normal or subgravitational conditions.

AIR CONDITIONING IN UPPER SPACE. Frederick H. Green. Western Aviation, Feb.1956, p.12-14,16. Analysis of the problem of air conditioning manned satellites, taking into account such factors as the provision of oxygen, pressurization, humidity and temperature control, and leaks.

A STUDY OF THE RATE PROCESS OF LIFE AND SPECIAL RELATIVITY. William R. Brewster. American Rocket Society Preprint 376-56, 1956.

PERSONAL EXPERIENCES DURING SHORT PERIODS OF WEIGHTLESSNESS REPORTED BY SIXTEEN SUBJECTS. Siegfried J. Gerathewohl. Astronautica Acta, v.2, no.4, 1956, p.203.

SOME CONSIDERATIONS IN REGARD TO THE PHYSIOLOGY OF SPACE FLIGHT. F. A. Hitchcock. Astronautica Acta, v.2, no.1, 1956, p.20-24. Physiological stresses that will be encountered in space flight; exposure to barometric pressures lower than 47 mm Hg (63,000 ft) will produce all of harmful effects that would occurr in vacuum; from physiological viewpoint any flight above 63,000 ft. may be considered as space flight; sealed cabins provided with air conditioned artificial atmosphere must be used; physiological responses of living animals to vacuum.

SIMULATED TRAINING FOR ROCKET AIRCRAFT. J. N. Pecoraro. American Rocket Society. Preprint 333-56, 1956.

MAN'S ADAPTATION TO INCREASING ALTITUDE. J. R. Poppen. Society of Automotive Engineers Preprint 749, 1956. Barriers to man's ascent to higher altitudes listed; atmospheric barriers can be met by pressurized and conditioned compartments with equable artificial environment; adaptation to velocity accomplished by designing protective equipment; barrier of vision surmounted by providing realistic data presentation; direct electronic control and appropriate illumination; protective means available to obviate harmful effects of unusual radiations. (CN-44004)

ENGINEERING FOR PHYSIOLOGICAL REQUIREMENTS: Hubertus O. Strughold. Taken from: Orbital and Satellite Vehicles, v.1 and v.2. Edited by

HUMAN AND SPACE MEDICAL PROBLEMS - Continued

Paul E. Sandorff, Massachusettes Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

1955

PROBLEMS OF WEIGHTLESSNESS. P. K. Isakov. Rand Corp. RM-1760, p.229-239. Translation from Nauka i Zhizn, v.22, no.12, Dec.1955, p.17-20. (CN-47550 pt.1)

METHOD OF SEALING AND GAS-CONDITIONING ORBITAL DUTY SURVIVAL SUIT. M. C. Paul. Journal of the British Interplanetary Society, v.14, no.6, Nov.-Dec.1955, p.300-306. Construction and operation of annular-waist seal examined together with relevant suit envelope problems and design; tests on crude prototype seal; gas conditioning system permitting minimum of internal suit apparatus and wiring.

THE GREAT DANGER: THE CORPUSCULAR RAYS FROM THE SUN. C. E. Andersen. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

THE PRESENT STATUS OF BIOLOGICAL COSMIC RAY RESEARCH. J. Eugster. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

AVIATION MEDICINE ON THE THRESHOLD OF SPACE. Allan C. Fisher, Jr. National Geographic Magazine, v.108, no.2, Aug.1955, p.241-78. Service doctors, facing medical problems unknown on earth make possible man's exploration of the hostile heavens.

COSMIC RAY EFFECTS ON BALLOON-BORNE BIOLOGICAL SPECIMENS. D. G. Simons, and C. H. Steinmetz. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

SYNTHETIC TRAINING FOR SPACE FLIGHT. G. Vincent Amico. Institute of Radio Engineers National Convention, New York, Mar.21-24,1955, pt.10, p.49-54. (N-39571)

BIOLOGICAL EXPERIMENTATION WITH AN UNMANNED TEMPORARY SATELLITE. APP.B OF: ON THE UTILITY OF AN ARTIFICIAL UNMANNED EARTH SATELLITE. Hermann J. Schaefer. Jet Propulsion, v.25, no.2, Feb.1955, p.72-73.

ACCELERATION FORCE AND SPACE PILOT. J. J. Raffone. Journal of Astronautics, v.2, no.3, 1955, p.100-104. Effect of G (force on body in multiples of bodies weight) on space pilot; forces leading to grayout, blackout, and unconsciousness; advantages of supine position.

1954

DESIGNING COCKPIT FOR HIGH-SPEED FLIGHT. S. N. Roscoe. Aeronautical Engineering Review, v.13, no.12, Dec.1954, p.47-51,58. Basic problems, nature and order of benefit to be expected from their experimental investigation; need for research in design of controls and visual displays to be used in directing aircraft through space.

HUMAN AND SPACE MEDICAL PROBLEMS - Continued

DESIGN OF LIFE COMPARTMENT NECESSARY FOR SPACE TRAVEL. N. R. Nicoll. Journal of the British Interplanetary Society, v.13, no.5, Sept.1954, p.277-282. Composition of life compartment of spaceship; overall weight of under one ton arrived at; compartment is of double walled construction, containing equipment for atmosphere control, and other necessities for survival of crew of three for 15 days.

SPACE MEDICINE. Herbert Segal. Journal South African Interplanetary Society, Apr.-Sept.1954, pp.24-29. Medical problems under weightless conditions outside the earth's gravitational field in terms of selection of the crew, take off, flight, landing, and life on the objective.

DEMONSTRATION REGARDING PROOF OF COSMIC RADIATION IN THE HUMAN BODY. (DEMONSTRATION UBER DEN NACHWEIS DER KOSMISCHEN STRAHLUNG IM MENSCHLICHEN KORPER). J. Eugster. (German text). Fifth International Astronautical Congress, Innsbruck. Aug.5-7, 1954, p.188-189. (N-46768)

FUNDAMENTALS REGARDING SPACE-DIVER "ARMOR". (Grundsatzliches zur Raumtaucherrustung). Hermann J. Oberth. (German text). Fifth International Astronautical Congress, Innsbruck, Aug.5-7,1954, p.1-12. (N-46768)

MAN AND MACHINE BETWEEN ATMOSPHERE AND SPACE. Heinz Haber. (Presented at annual summer meeting of IAS, Los Angeles, June 21-24,1954). IAS Preprint 473. (N-32255)

REVIEW OF BIOLOGICAL EFFECTS OF SUBGRAVITY AND ZERO-GRAVITY. David G. Simons. American Rocket Society Preprint 139-54. 1954.

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TESTS OF WEIGHTLESSNESS DURING VERTICAL DIVES BY TEST PERSONS AND ANIMALS. Harald J. A. von Beckh. 4th International Astronautical Congress, held at Zurich, Aug.3-8, 1953. By means of tests during power dives, which have simulated the conditions of weightlessness for periods up to seven seconds, disturbances in the sense of direction and of coordination could be observed. Tests with humans proved that the disturbances in muscular balance can be eliminated if the subject is first instructed how to control his actions solely by a sense of sight.

METHODS OF INVESTIGATION APPLIED TO RESEARCH ON THE BIOLOGICAL EFFECTS OF COSMIC RAYS AT HIGH ALTITUDES. J. Eugster. 4th International Astronautical Congress, held at Zurich, Aug.3-8,1953. It is shown in an extensive series of tests that it is possible to detect cosmic rays by chemical means.

THE FOOD AND ATMOSPHERE CONTROL PROBLEM IN SPACE VESSELS. PART II: THE USE OF ALGAE FOR FOOD AND ATMOSPHERE CONTROL. Norman J. Bowman. Journal of the British Interplanetary Society, v.12, no.4, July,1953, p.149.

HUMAN AND SPACE MEDICAL PROBLEMS - Continued

SPACE PHYSIOLOGY. C. R. Armstrong. Journal of the British Interplanetary Society, v.12, no.4, July,1953, p.172.

THE FOOD AND ATMOSPHERE CONTROL PROBLEM ON SPACE VESSELS. PART I: CHEMICAL PURIFICATION OF AIR. Norman J. Bowman. Journal of the British Interplanetary Society, v.12, no.3, May,1953, p.118.

MAN'S SURVIVAL IN SPACE. Collier's, v.28, Feb.1953.

1952

A METHOD OF SUPPORTING THE HUMAN BODY STRUCTURE DURING SPACE FLIGHT. Michael Conley. Journal of Space Flight, v.4, no.9, Nov. 1952, p.3.

HUMAN FLIGHT AT THE LIMITS OF THE ATMOSPHERE; G-FORCES AND WEIGHT IN SPACE TRAVEL. Fritz Haber. (Lecture, Second Symposium on Space Travel; Hayden Planetarium, New York, Oct.13,1952). Journal of the British Interplanetary Society, v.12, no.1, Jan.1953, p.32.

MANNED FLIGHT AT THE BORDERS OF SPACE. Heinz Haber. (Presented at fall meeting of American Rocket Society, Chicago, Sept.9,1952). American Rocket Society, Journal, v.22, no.5, Sept.-Oct.1952, pp.269-276,283.

SENSORY PERCEPTIONS OF THE WEIGHTLESS CONDITION. Alan E. Slater. (German summary and English text). Proceedings of the Third International Astronautical Congress, Stuttgart, Sept.1-6, p.219-225. One of the unsolved problems of space flight is the question whether the passengers will be able to tolerate the absence of any sensation of weight. There are four principal kinds of bodily sensation which give us a sense of gravitational pull, either consiously or unconsciously. So the question to be answered is whether the absence of all four together will give rise to discomfort. (N-53323)

EXPOSURE HAZARD FROM COSMIC RADIATION AT EXTREME ALTITUDE AND IN FREE SPACE. Hermann J. Schaefer. Proceedings of the third International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.201-210. American Rocket Society, Journal, v.22, no.5, Sept.-Oct.1953, pp.277-283. Report is limited to the question of what possible effects on the human organism might result from an exposure in the region of the primary cosmic radiation at the upper end and outside the terrestrial atmosphere where the radiation intensity is about 150 times higher than at sea level. (N-53323)

PHYSICAL RELATIONSHIPS AND CONDITIONS FOR LIFE ON OTHER PLANETS. (PHYSISCHE VERHALTNISSE UND LEBENSBEDINGUNGEN AUF ANDEREN PLANETEN). Hans A. Kaiser. (English summary and German text). Proceedings of the 3rd International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.226-238. According to these results human life is possible only on the earth. Venus, at present surrounded yet by a thick atmosphere of CO_2, will be able

perhaps to bear higher forms of organic life after some millions of years. Mars doubtless is a home of a primitive vegetation. All the other planets come into question. (N-53323)

BIOLOGICAL EFFECT OF COSMIC RADIATION, METHODS AND MOST RECENT RESULTS. (DIE BIOLOGISCHE WIRKUNG DER KOSMISCHEN STRAHLUNG; METHODEN UND NEUESTE ERGEBNISSE). J. Eugster. (English summary and German text). Proceedings of the Third International Astronautical Congress, Stuttgart, Sept.1-6, 1952, p.211-218. A description is given of a new method permitting the demonstration of cosmic radiation tracks in living tissue as well as the chemical effect on dyes and enzymes (TTC, enzymes with SH-groups). (N-53323)

ESCAPE AND SURVIVAL IN SPACE TRAVEL. Fritz Haber. American Rocket Society, Preprint 68-52. 1952.

GENETIC EFFECTS OF COSMIC RADIATION. H. Muller. University of New Mexico Press, 1952. (629.1356 P56)

THE ATMOSPHERES OF EARTH AND MARS IN THE LIGHT OF RECENT PHYSIOLOGICAL CONCEPTS. Hubertus O. Strughold. American Rocket Society. Preprint 67-52, 1952.

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KNOWN AND PREDICTED PROBLEMS OF HUMAN TRAVEL IN THE AEROPAUSE. Paul A. Campbell. (Prepared discussion of papers by various authors. Proceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9, 1951. University of New Mexico Press, 1952, p.479. (629.13256 P56)

HUMAN ORIENTATION DURING TRAVEL IN THE AEROPAUSE. Paul A. Campbell. Proceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9,1951. University of New Mexico Press, 1952, p.488-493. (629.13256 P56)

A DISCUSSION OF THE POTENTIAL EFFECTS ON MAN OF IONIZING RADIATION PRESENT IN THE UPPER ATMOSPHERE. Titus C. Evans. Proceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9,1951. University of New Mexico Press, 1952, p.533-539. (629.13256 P56)

GRAVITY, INERTIA, AND WEIGHT. Heinz Haber. Proceedings of a symposium on the physics and medicine of the upper atmosphere held at San Antonio, Texas, Nov.6-9,1951. University of New Mexico Press, 1952, p.123-136. (629.13256 P56)

BASIC ENVIRONMENTAL PROBLEMS RELATING MAN AND THE AEROPAUSE. Alfred M. Mayo. Proceedings of a symposium on the physics and medicine of the

HUMAN AND SPACE MEDICAL PROBLEMS - Continued

upper atmosphere held at San Antonio, Texas, Nov.6-9,1951. University of New Mexico Press, 1952, p.6-22. (629.13256 P56)

THE BIOLOGIC EFFECTS OF COSMIC RADIATION. Hermann J. Schaefer. Proceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9,1951. University of New Mexico Press, 1952, p.290-315. (629.13256 P56)

ENGINEERING TECHNIQUES IN RELATION TO HUMAN TRAVEL AT UPPER ALTITUDES. R. M. Salter. Proceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9,1951. University of New Mexico Press, 1952, p.480-487. (629.13256 P56)

TOXICOLOGY OF TRAVEL OF AEROPAUSE. H. Specht. Proceedings of a symposium on the physics and medicine of the upper atmosphere held at San Antonio, Texas, Nov.6-9,1951. University of New Mexico Press, 1952, p.171-181. (629.13256 P56)

BASIC ENVIRONMENTAL PROBLEMS RELATING TO MAN IN THE "AEROPAUSE". A. M. Mayo. Douglas Aircraft Co., Nov.6,1951. (N-13237)

BIOLOGICAL PROBLEMS OF THE EARTH SATELLITE VEHICLE. P. Bergeret. Paper read at Second International Congress on Astronautics, London, Sept.3-8,1951. One of the major unknowns is the effect of zero-g or "free fall" conditions on the human body during a prolonged period. Another important problem is the effect of all the radiations normally stopped by the earth's atmosphere, but no doubt a suitable screen could be found.

BIOLOGICAL PROBLEMS OF SPACE FLIGHT. J. B. S. Haldane. Journal of the British Interplanetary Society, v.10, no.4, July 1951, p.154.

PHYSIOLOGICAL ASPECTS OF INTERPLANETARY TRAVEL. A. V. St.Germain. American Helicopter, Jan.1951, pp.1-12,19.

SPCAE MEDICINE; THE HUMAN FACTOR IN FLIGHTS BEYOND THE EARTH. John Porter Marbarger, ed. Univ. of Illinois Press, 1951, 83p. See especially Chapter II: Multi-stage rockets and artificial satellites, by W. von Braun.

ORIENTATION IN SPACE. P. A. Campbell. Space Medicine, p.62-69 and University of Illinois Press, 1951.

RADIATION OF MAN IN SPACE. K. Buttner. Bulletin of the American Meteorological Society, v.32, 1951, p.183-185.

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LUNAR SPACESUIT. Harry E. Ross. Journal of the British Interplanetary Society, v.9, no.1, Jan.1950, p.23-36. (6510 JBIS/1950, v.9, no.1).

HUMAN AND SPACE MEDICAL PROBLEMS - Concluded

PSYCHOLOGICAL PROBLEMS OF SPACE-FLIGHT. E. T. O. Slater. Journal of the British Interplanetary Society, v.9, no.1, Jan.1950, p.14-18. (6510 JBIS/1950, v.9, no.1)

THE BALANCING MECHANISM OF THE INNER EAR. A. E. Slater. Journal of the British Interplanetary Society, v.9, 1950, p.18-23.

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NUTRITIONAL AND OTHER PHYSIOLOGICAL ASPECTS OF EXTENDED SPACE FLIGHTS, PARTS I AND II. Norman J. Bowman. Chicago Rocket Society, Collection Tech. Repts., v.2, 1951, p.41 and 47. Rocket News Letter, v.2, no.7, Feb.1949. Rocket News Letter, v.2, no.8, Mar.1949.

BIOLOGICAL ASPECTS OF A SPACE JOURNEY. Vincent Story. Chicago Rocket Society, Collection Tech. Repts., v.1, 1949, p.48. The Rocket News Letter, v.1.

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1958

A NUCLEAR MAGNETOMETER. G.S. Waters and P.D. Francis. Journal of Scientific Instruments, v.35, no.3, Mar.1958, p.88-93.

LABORATORY SIMULATION OF SPACE FLIGHT CONDITIONS. T.C. Helvey, Martin Co. American Astronautical Society, Annual meeting, New York, Jan.29-31,1958.

PLASTIC BALLOON FOR PLANETARY RESEARCH. Malcolm D. Ross. American Astronautical Society, Annual meeting, New York, Jan.29-31,1958. A unique opportunity for astrophysical observations is afforded by large constant-level plastic balloons. Under a broad program of high-altitude research supported by the ONR two types of balloon systems are available for this type exploration. By means of a fully instrumented system known as Stratoscope, and an instrumented version manned with human observers, called Strato-Lab, excellent opportunities are available for planetary research. Capabilities of these systems are discussed.

A RECOVERABLE EMULSION PACKAGE FOR EXTRA-ATMOSPHERIC STUDY OF COSMIC RAYS. Robert A. Webster. American Astronautical Society, Annual meeting, held in New York, Jan.29-31,1958. This paper describes and discusses an extra-atmospheric recoverable cosmic-ray emulsion package developed by the Martin Co.

A RECOVERABLE SPACE VEHICLE FOR COSMIC RAY RESEARCH. Robert A. Webster. (Presented at 4th annual meeting of the American Astronautical Society, New York, Jan.29-31,1958). American Astronautical Society Preprint 57-32. (CN-59324)

THE ROLE OF MANNED BALLOONS IN THE EXPLORATION OF SPACE. Malcolm D. Ross and M. Lee Lewis. (Presented at 26th annual meeting, IAS, Jan.27-30,1958). Institute of the Aeronautical Sciences. Preprint 834. (CN-58729)

THE 3 MANNED STRATOSPHERE BALLOON ASCENTS OF 1957. Otto C. Winzen. (Presented at 26th annual meeting, IAS, Jan.27-30,1958). Institute of the Aeronautical Sciences. Preprint 833. The three flights discussed are Manhigh I on June 2, Manhigh II on Aug.19-20, and Strato-Lab II on Oct.18. Includes a table of stratosphere balloon ascents from 1931-1957 and tables of the Manhigh and Strato-Lab. systems weight breakdown. (CN-58757)

THE PLASTIC BALLOON AS A GEOPHYSICAL PLATFORM. Richard H. Braun. (Presented at 26th annual meeting, IAS, New York, Jan.27-30,1958). Institute of the Aeronautical Sciences, Inc., Preprint 823. (CN-58765)

RESEARCH USES, STUDIES, AND INSTRUMENTATION
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MAGNETIC CORE EVENT COUNTER FOR EARTH SATELLITE MEMORY. D.H. Schaefer. Electrical Engineering, Jan.1958, p.52-56. Description of the circuit of a micrometeorite bombardment counter for space satellites.

EXPLORATION OF THE UPPER ATMOSPHERE. D.R. Bates. (In Space Research Exploration, edited by D.R. Bates). 1958. (629.1388 B31)

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INSTRUMENTATION FOR A COSMIC RAY EXPERIMENT FOR THE MINIMAL EARTH SATELLITE. George H. Ludwig and James A. Van Allen. Journal of Astronautics, Autumn-Winter, 1957, pp.59-60, 80. Discussion of a proposed experiment in which a single Geiger-Mueller counter would be used to study the geographical and temporal variations of the primary cosmic-ray intensity. The counter would incorporate a system for storing its output during the orbit of the satellite, and for short-time read-out of this information.

U.S. ARMY SUPPORT OF SCIENTIFIC ACTIVITIES IN ASTRONAUTICS. Holger Nelson Toftoy. (Presented at 8th International Astronautical Congress, Barcelona, Spain, Oct.6-12,1957.) American Rocket Society Preprint 505-57. (CN-57906)

INTERPLANETARY BALLISTIC MISSILES: A NEW ASTROPHYSICAL RESEARCH TOOL. Siegfried Fred Singer. Paper given at the 8th International Astronautical Congress, Barcelona, Oct.6-12,1957. American Rocket Society Preprint 492-57. Astrophysical applications are discussed under the headings: visible effects; ultraviolet, X-rays and gamma-ray radiation; corpuscular radiation; radio signal from the explosion; lunar material captured by the earth. (CN-59136)

THE COMMUNICATION SATELLITE. R.P. Haviland. Paper given at the Eighth International Astronautical Congress, Barcelona, Oct.6-12,1957. American Rocket Society Paper 487-57. The interrelations between an artificial satellite and the earth, and the characteristics of satellites are reviewed to determine their effect on communication systems (telephony, television, and radio broadcasts). The requirements for typical communication systems are studied. A set of services are proposed for incorporation in a large earth satellite. (CN-57892)

10 YEARS OF PLASTIC BALLOONS. Otto C. Winzen. (Presented at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957). American Rocket Society Paper 490-57. The modern plastic balloon in its very short history has become a recognized vehicle for serious upper atmosphere research operations supported by all research

branches of the Armed Forces of the U.S. This paper discusses the development in general and mentions the following specific projects: Project Skyhook, Moby Dick, Project Transo-sonde, Rockoon, Project Strato-Lab., animal cosmic ray flights, Project Manhigh, and Project Sky-Car. (CN-57887)

BALLOONS PLAY KEY ROLE IN UPPER ATMOSPHERE RESEARCH WITH ROCKETS Otto C. Winzen. (Paper given at the Eighth International Astronautical Congress, Barcelona, Oct.6-12,1957). The development of the Skyhook balloon, made of thin polythene film, and methods of construction and handling. Use in the Rockoon projects, in which balloon-launched rockets are employed for upper atmosphere investigations; construction of the capsule and balloon for the Man-High II project, and launching technique.

RESEARCH GOALS IN ASTRONAUTICS. W.O. Davis. (Presented at 8th International Astronautical Congress, Barcelona, Spain, Oct.6-12,1957). American Rocket Society. Preprint 506-57. (CN-59167)

THE USE OF PROBE ROCKETS. C.A. Cross. Journal of the British Interplanetary Society, v.16, no.3, July-Sept.1957, p.148-162. Discussion of the uses and operation of probe rockets that are not restricted to a closed orbit around the Earth. Orbits around the Moon, Mars, and Venus are considered, and the prospects for direct investigation of planetary surfaces by remotely controlled landings are examined.

IGY ROCKET PROGRAM. Scientific Monthly, Sept.1957, p.130-142. Discussion of the scientific phenomena to be explored during IGY and of the rocket vehicles to obtain such data.

LANDING A ROCKET ON THE MOON. C.A. Cross. Aeronautics, v.37, no.1, Sept.1957, p.128-129. Describes an analogue computer which simulates a rocket falling vertically on the moon. If the rocket motor is not used the rocket crashes at 8,200 km/hr (5,100 ml/hr), but by correct operation of the motor it may be retarded so as to make a safe landing. The analogue has been used to test the performance of individuals making such a landing by manual control. Contrary to expectation it has been shown that most people can be trained to land the rocket safely.

STUDY OF THE VARIATION OF COSMIC RADIATION. (ISSLEDOVANIE VARIATSII KOSMICHESKOGO IZLUCHENIIA). Russian text. S.N. Vernov, Iu. I. Logachev, A.E. Chudakov, and Iu. G. Shafer. (Presented at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957). Uspekhi Fizicheskikh Nauk, v.63, no.1b,

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Sept.1957, p.149-162. (Translated version to be published in the near future by U.S. Joint Publications Service). The possibility of using an artificial satellite for studing cosmic radiation; construction of the equipment needed.

INVESTIGATION OF THE IONIC COMPOSITION OF IONIZED ATMOSPHERIC LAYERS. (ISSLEDOVANIE IONNOGO SOSTAVA IONIZIROVANNYKH SLOEV ATMOSFERY). Russian text. B.A. Mirtov and V.G. Istomin. Uspekhi Fizicheskikh Nauk, v.63, no.1b, Sept.,1957, p.227-238. (Translated version to be published in the near future by U.S. Joint Publications Service). Chemical composition of the ionosphere; possibilities of using an artificial satellite for such study.

INVESTIGATION OF THE SOLID COMPONENTS OF INTERPLANETARY SPACE BY MEANS OF ROCKETS AND ARTIFICIAL SATELLITES. (ISSLEDOVANIE TVERDOI SOSTAVLIAIUSHCHEI MEZHPLANETNOGO VESHCHESTVA S POMOSHCH'IU RACKET I ISKUSSTVENNYKH SPUTNIKOV ZEMLI). Russian text. S.M. Soloskov and T.N. Nazarova. Uspekhi Fizicheskikh Nauk, v.63, no.1b, Sept. 1957, p.253-265. (Translated version of this paper to be published in the near future by U.S. Joint Publications Service). Discussion of the two most important problems which should be investigated; determination of the flow of meteor particles and study of their spectra.

THE USE OF ARTIFICIAL EARTH SATELLITES FOR THE PURPOSE OF PROVING GENERAL RELATIVITY THEORY. V.L. Ginzburg. (Presented at Conference on Earth Satellites, Washington, D.C., Oct.2-5,1957). U.S. Joint Publications Research Service, Rept.187, p.175-180. (N-58836, pt.1). Translation from Uspekhi Fizicheskikh Nauk, v.63, no.1a, Sept.1957, p.119-122. Discussion covering the use of artificial earth satellites in the verification of the general theory of relativity.

ISSLEDOVANIE TZERDOI SOSTAVLIAIUSHCHEI MEZHPLANETNOGO VESHCHESTVA S POMOSHCH'IU RAKET I ISKUSSTVENNYKH SPUTNIKOV ZEMLI. Russian text. S.M. Poloskov and T.N. Nazarova. Uspekhi Fizicheskikh Nauk, no.1b, Sept.1957, p.253-265. (Translated version to be published in the near future by U.S. Joint Publications Service). Investigation of the solid interplanetary matter by means of rocket and earth satellite measurements.

STUDY OF ULTRA-VIOLET SHORT-WAVE SUN RADIATION. (ISSLEDOVANIIA KOROTKOVOLNOVOGO UL'TRAFIOLETOVOGO IZLUCHENIIA SOLNTSA). Russian text. S.L. Mandel'shtam and A.I. Efremov. Uspekhi Fizicheskikh Nauk, v.63, no.1b, Sept.1957, p.163-180. (Translated version to be published in the near future by U.S. Joint

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Publications Service). Theoretical and experimental data related to radiation of waves shorter than 2900Å; description of experiments which are planned using an artificial satellite.

IZMERENIE ELEKTROSTATICHESKIKH POLEI V VERKHNIKH SLOIDAKH ZEMNOI ATMOSFERY. (Russian text). I.M. Imianitov. Uspekhi Fizicheskikh Nauk, no.1b, Sept.1957, p.267-282. (Translated version to be published in the near future by U.S. Joint Publications Service). Measurement of electrostatic fields in the upper layers of the atmosphere.

MEASURING THE POSITIVE ION CONCENTRATION ALONG THE ORBIT OF AN ARTIFICIAL SATELLITE. (IZMERENIE KONSTSENTRATSII POLOZHITEL'NYKH IONOV VDOL' ORTIBY ISKUSSTVENNOGO SPUTNIKA ZEMLI). (Russian text). K.I. Gringauz and M.Kh. Zelikman. Uspekhi Fizicheskikh Nauk, v.63, no.1b, Sept.1957, p.239-252. The possibilities of using an artificial satellite in study of the concentration of ions and electrons in the ionsphere.

PROBLEMS OF MEASUREMENT OF PRESSURE AND DENSITY OF HIGH-ATMOSPHERIC LAYERS BY MEANS OF AN ARTIFICAL SATELLITE. (IZADACHA IZMERENIIA DAVLENIIA I PLOTNOSTI VYSOKIKH SLOEV ATMOSFERY S POMOSHCHIU ISKUSSTVENNOGO SPUTNIKA ZEMLI). Russian text. B.S. Danilin, V.V. Mikhnevich, A.I. Repnev, and E.G. Shvidkovskii. Uspekhi Fizicheskikh Nauk, v.63, no.1b, Sept.1957, p.205-225. (Translated version of this paper is to be published in the near future by U.S. Joint Publications Service).

THE "CLOCK PARADOX" AND SPACE TRAVEL. Edwin M. McMillan. Science, Aug.30,1957, pp.381-384.

ROCKETS AND ARTIFICAL SATELLITES IN STUDIES OF THE UPPER ATMOSPHERE. (RAKETY I ISKUSSTVENNYE SPUTNIKI ZEMLI V ISSLEDOVANIIAKH VERKHNEI ATMOSFERY). (Russian text). E.K. Fedorov and G.A. Skuridin. Vestnik Akademii Nauk SSSR, v.27, no.8, Aug.1957, p.37-48. Survey of work done in the USA and Soviet Union in studying the upper atmosphere, and use of rockets in these studies. Description of several possible types of future artificial satellites. (CN-58666)

THE SCIENTIFIC APPLICATIONS OF ROCKETS AND SATELLITES. H.S.W. Massey. (Paper given at the Cranfield Symposium, July 18-20,1957). Spaceflight, v.1, no.5, Oct.1957, p.173 (summary of paper). Rockets are essential for some high altitude research studies, particularly for work on solar radiation. Research with rockets has become experimental as well as observational, an example of the former being the study of the effects of solar radiation on sodium

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vapour discharged into the atmosphere from the rocket. Satellite rockets are needed for the study of the variation of phenomena with time and latitude.

ROCKETS AS A RESEARCH TOOL. Peter H. Wyckoff. (Presented at a special meeting of the U.S. National Committee for the IGY, June 27-29,1957). News release of the National Academy of Sciences, June 29,1957.

SCIENTIFIC INSTRUMENTATION OF THE SATELLITE. James A. Van Allen. Presented at a special meeting of the U.S. National Committee for the IGY, June 27-29,1957. News release of the National Academy of Sciences, June 29,1957.

SCIENTIFIC INSTRUMENTATION IN IGY SATELLITES. Herbert Friedman. Electrical Engineering, June 1957, pp.470-474.

STUDY OF THE UPPER ATMOSPHERE BY MEANS OF ROCKETS AT THE USSR ACADEMY OF SCIENCES. S.M. Poloskov and B.A. Mirtov. Rand Corp. RM-1922, p.151-162. (CN-47550, pt.2). Journal of the British Interplanetary Society, v.16, no.2, Apr.-June 1957, p.95-100. Translation. Discussion of the Russian program for IGY and a brief description of various testing devices to be employed.

ROCKETS EXPLORE THE AIR ABOVE US. Newman Bumstead. National Geographic, v.111, no.4, Apr.1957, p.562-580. Scientists, firing missiles equipped with electronic eyes and ears, probe mysteries on the borders of outer space.

MAGNETIC FIELD, COSMIC RAY AND ION DENSITY MEASUREMENTS IN INTERPLANETARY SPACE. Ralph J. Haven. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. He has calculated the weights required to send up to 10^6 miles experiments to answer some of the basic questions with regard to these 3 unknowns, magnetic fields, cosmic rays, and ion density.

INTERACTION OF EXTREME UV RADIATION WITH MATTER. Hans E. Hinteregger. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Stressed problems that need to be studied in the laboratory, particularly with radiation below 900A. Discussed the type of laboratory research and also rocket and satellite research that is needed in the extreme ultraviolet to find the interaction with matter.

POSSIBILITIES FOR MEASURING GAS COMPOSITION AT VERY HIGH ALTITUDES. Nelson W. Spencer. Astronautics symposium, held in San Diego, Feb-18-20,1957, under sponsorship of Office of Scientific Res. and

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Convair. The desired result, to conduct spectrometer-type composition experiments to altitudes with the range of instruments that are postulated, is seen feasible to the order of 10^{-11} milobars (10^{-14} atmospheres). He discussed problems and detailed techniques that might be utilized in making measurements at the 200 to 300 kilometer level and above.

CURRENT STATUS OF THE U.S. EARTH SATELLITE PROGRAM FOR THE INTERNATIONAL GEOPHYSICAL YEAR. Richard William Porter. (Presented at IAS 25th annual meeting, Jan.28-31,1957). Institute of the Aeronautical Sciences. Preprint 726. Characteristics of the satellite to be used in the U.S. Earth Satellite program are presented. The four principle experiments to be conducted using instruments in the satellite are discussed and experiments which do not depend on internal instrumentation are also reviewed. (CN-48283)

USE OF AN ARTIFICIAL SATELLITE IN UPPER AIR RESEARCH. Hildegard Korf Kallmann and William Welch Kellog. Bul. AMS, Jan.,1957, pp.17-19. Discussion of the types of data to be collected by satellites and their scientific applications.

RESEARCH GOALS IN ASTRONAUTICS. William O. Davis. American Rocket Society Preprint 506-57. (1957).

INSTRUMENTED COMETS - ASTRONAUTICS OF SOLAR AND PLANETARY PROBES. Krafft A. Ehricke. American Rocket Society Preprint 493-57. (1957). (CN-58811)

THE USES OF ARTIFICIAL SATELLITE VEHICLES, PT.2. H.E. Canney and F.I. Ordway. Astronautica Acta, v.3, no.1, 1957, p.1. Discussion of the satellite as an observation and military base, a communications relay station, and a radar beacon.

A NEW MICROBALANCE OF QUARTZ FOR WORK UNDER HIGHEST VACUUM. Herbert Mayer and Klaus Behrndt. Zeitschrift für Physik, v.147, no.4, 1957, p.499-506 Translation. (NACA Unpub. TM - CN-52538)

1956

STRATO-LAB DEVELOPMENT. R.L. Schwoebel. (Covers period May 4, 1955-Nov.12,1956). General Mills, Inc. Rept. 1648. Dec.31,1956. The objective of the Strato-Lab program was to provide a safe and convenient vehicle to carry scientists into the upper atmosphere. The purpose of this report was to record the technical progress on this program within the General Mill's group. The report includes studies on the balloon, the parachute and the gondola. A description is given of the first Strato-Lab personnel flight of Nov.8,1956

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which reached an altitude of 76,000 feet. (CN-48125)

EXPERIMENTAL ASPECTS OF GENERAL RELATIVITY THEORY. Louis Witten. Proceedings of the 3rd American Astronautical Society, Dec.6-7, 1956, p.127-133. The general relativity theory is discussed, and an outline of the several experimental verifications of the theory is reviewed. These include the perihelion advance of the planet Mercury, the gravitational displacement of spectral lines, and the gravitational deflection of light rays. Consideration is given to the use of atomic clocks having accuracies of the order of 1 part in 10^{12} in discerning the time shift predicted by the theory of relativity. (N-58942)

THE SATELLITE AND METEOROLOGY. Harry Wexler. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.5-15. (New York, N.Y.) (N-58942)

SPACE VEHICLES AS TOOLS FOR RESEARCH IN RELATIVITY. Siegfried Fred Singer. Proceedings of the 3rd American Astronautical Society, New York, Dec.6-7,1956, p.121-125. (N-58942). Journal of Astronautics, v.4, no.3, Autumn 1957, p.49-51. The twin paradox from the special theory of relativity is discussed. Special attention is given to a presentation of the application of close orbit earth satellites, with the aid of atomic clocks, to perform an experimental test of relativity. Discusses the long standing controversy of the twin paradox and states conclusively that a time advantage will exist for the traveler on extended space voyages.

COSMIC RAY INSTRUMENTATION FOR THE IGY PROGRAM. Robert C. Haymes. Proceedings of the 3rd American Astronautical Society, Dec.6-7, 1956, p.65-75. Meson telescope, neutron monitor and a balloon-borne system developed at New York University are described. This description will include a discussion of the problem of cosmic-ray detection, atmospheric-pressure measurement, telemetering and data recording. (N-58942)

ELECTRON DENSITIES OF THE IONOSPHERE UTILIZING HIGH-ALTITUDE ROCKETS. Doran J. Baker, compiler. Upper Air Research Labs., U. of Utah Scientific Rept.2. Describes the determination of the electron density of the E-region of the earth's ionosphere, and its variations in both time and space. The method of attack is the use of radio-frequency pulses transmitted through the region from a high-altitude rocket to the ground. (CN-56898)

CHEMISTRY IN SPACE FLIGHT. I. The USE OF COBALTOUS BIS SALICYLIDENE ETHYLENDEDIAMINE IN PLANETARY EXPLORATION. Wayne Proell. Journal of Space Flight, Nov.1956, p.1-5.

RESEARCH USES, STUDIES, AND INSTRUMENTATION
(Also satellite test apparatus) - Continued

THE ARTIFICIAL SATELLITE AS A RESEARCH INSTRUMENT. James Alfred Van Allen. Scientific American, v.195, no.5, Nov.1956, p.41-47. The details of its launching and instrumentation have begun to come into focus. If all goes well, the first of them will be in orbit by early 1958, during the IGY.

APPLICATION OF ARTIFICIAL SATELLITE TO MEASUREMENT OF GENERAL RELATIVISTIC "RED SHIFT." Siegfried Fred Singer. Physical Review, v.104, no.1, Oct.1,1956, p.11-14. Possible use of earth satellites to test general theory of relativity; relativistic satellite clock measurements calculated; with respect to earth clock there would be "red shift" for low altitudes, zero shift at orbit at one-half of earth's radius, and "violet shift" for higher altitudes; experimental schemes.

HIGH ALTITUDE RESEARCH. Eric Burgess. Journal of the British Interplanetary Society, v.15, no.5, Sept.-Oct.1956, p.261-280. Discussion reviewing the development of appropriate vehicles and the peculiarities connected with rocket experiments in this field, describing types of experiments undertaken and particulars of the instrumentations involved, and explaining data-recovery methods.

SPACE TRAVEL AND FUTURE RESEARCH INTO STRUCTURE OF UNIVERSE. J.M.J. Kooy. Journal of the British Interplanetary Society, v.15, no.5, Sept.Oct.1956, p.248-258. Extensive program of astronomical observation is indicated in order to test alternative cosmological theories.

WHAT THE FUTURE HOLDS FOR THE EARTH SATELLITE. R.P. Haviland. Proceedings of the 3rd Americal Astronautical Society, Dec.6-7,1956, p.77-87. (N-58942). General Electric Review, v.59, no.5, Sept.1956, p.10-16. Journal of Astronautics, v.4, no.3, Autumn 1957, p.41-45, 51. Applications for earth satellites in the fields of mapping and geodesy, weather charting and forecasting and communications are reviewed. Consideration is given to the general characteristics of earth satellite trajectories and orbital motion.

OBSERVATIONS WITH SATELLITE-BORNE APPARATUS. James A. Van Allen. USNC-IGY Rocketry and Satellite Programs, National Academy of Sciences, U.S. National Committee for the IGY, Sept.1956. Compilation of five speeches presented at CASAGI Barcelona meeting, Sept. 1956.

EXPERIMENTAL VERIFICATION OF THE GENERAL THEORY OF RELATIVITY AND ARTIFICIAL SATELLITES OF THE EARTH. V.L. Ginzburg. Rand Corp. RM-1922, p.97-121. (CN-47550, pt.2).

RESEARCH USES, STUDIES, AND INSTRUMENTATION
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Priroda, v.45, no.9, Sept.1956, p.30-39, Translation. Soviet Physics, JETP, v.3, no.1, Aug. 1956, p.136-138, Translation.

SCIENTIFIC VALUE OF ARTIFICIAL SATELLITES. Fred Lawrence Whipple. Journal of the Franklin Institute, v.262, no.2, Aug.1956, p.95-109. Review of some research objectives, technical problems, and present plans concerning construction, instrumentation, launching and subsequent observation of artificial moons which are to revolve about the earth; status of developments forming part of IGY program.

METEOROLOGICAL MEASUREMENTS FROM A SATELLITE VEHICLE. W. Nordberg and William Graham Stroud. Signal Corps Engineering Lab. Tech. Memo. 1784. June 26,1956. The usefulness of an earth satellite in studying the meteorology of the earth is reviewed. The various levels of information available from the various levels of complexity of instrumentation are outlined. A specific instrumentation suitable for the initial (IGY) satellites is presented and the basic aspects of the operational problems outlined. It is shown that the necessary orientation information can be obtained from the albedo data. (CN-53521)

TELEVISION OF THE FUTURE (UTILIZATION OF ARTIFICIAL EARTH SATELLITE FOR WORLDWIDE TELEVISION BROADCASTING). V. Petrov. Rand Corp. RM-1922, p.63-79. Translation from Radio, no.6, June 1956, p.28-31. (CN-47550, pt.2).

INSTRUMENTATION PROBLEMS OF UNMANNED SATELLITES. Ernst Stuhlinger. (Presented at ARS semiannual meeting, Cleveland, June 18-20,1956). American Rocket Society. 306-56. Since the development of an unmanned satellite was publicly announced, a large number of proposals have been made on how this satellite could be used as a tool for scientific investigations. The usefulness of a satellite for scientific investigations depends mainly on its size, the available electric power, and the control of its attitude. In the present study, the capabilities of satellites for scientific measurements are investigated. A tentative scheme is offered which shows how the planning for satellite instrumentation might be scheduled. (CN-49375)

RECOVERY OF DATA IN PHYSICAL FORM (FROM A SATELLITE VEHICLE). Richard William Porter. Earth Satellites as Research Vehicles, Proceedings of the symposium held Apr.18,1956, Franklin Inst. Monograph 2. Discusses the recovery of data from a satellite vehicle in orbit, such as specimens of meteoric matter, photographic film samples of materials after exposure to satellite conditions, biological specimens, etc.

RESEARCH USES, STUDIES, AND INSTRUMENTATION
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ASTROPHYSICAL RESEARCH WITH AN ARTIFICIAL SATELLITE. Lyman Spitzer, Jr. Earth Satellites as Research Vehicles, Proceedings of the Symposium, held Apr.18,1956, Franklin Institute, Monograph 2. One of the most important scientific uses of a satellite could be measurement of astronomical spectra in the far ultra-violet, in the range between 600 and 3000A. Equipment needed and problems that could be investigated are discussed.

ASTRONAUTICAL AND SPACE-MEDICAL RESEARCH WITH AUTOMATIC SATELLITES. Krafft A. Ehricke. Earth Satellites as Research Vehicles, Proceedings of the symposium, Apr.18,1956, Franklin Institute, Monograph 2. Discusses the use of automatic satellites for the advancement of manned astronautics. The technical and scientific research aspects in conjunction with technological satellites are outlined and their correlation with various phases of manned astronautics is shown. The survey of the space-medical research by means of biosatellites also considered the relevant technical and scientific aspects.

SPACE SATELLITES, TOOLS OF EARTH RESEARCH. Heinz Haber. National Geographic, v.109, no.4, Apr. 1956, p.487-509.

SATELLITES FOR PHYSICISTS. Siegfried Fred Singer. Physics Today, v.9, no.4, Apr.1956, p.21-23. Significance of earth satellite to pure and applied physics; nature of orbital plane and mode of decay of orbit; measurement of solar ultraviolet and X-rays, cosmic ray intensity, magnetic fields at high altitudes, intensity of meteoric dust and density of upper atmosphere, aid in revealing nature of relativistic earthbound clock.

THE ARTIFICIAL EARTH SATELLITE - PAST, PRESENT, AND FUTURE. Siegfried Fred Singer. Interavia, Dec.,1956, p.956-959. Discovery, v.17, Apr.,1956, p.140-145. Discussion of the scientific research significance of the artificial satellite program, with emphasis on weather control.

SCIENTIFIC VALUE OF EARTH SATELLITE PROGRAM. James Alfred Van Allen. (Presented at Symposium on U.S. Earth Satellite Program - Vanguard of Outer Space, held at IRE National Convention, New York, Mar.19-22,1956). Institute of Radio Engineers, Proceedings, v.44, no.6, pt.1, June 1956, p.741-767. IRE Convention Record, pt.1, 1956, p.124-128. (CN-45812, pt.1)

EXPLORATION OF OUTER SPACE WITH EARTH SATELLITE. John P. Hagen. (Presented at Symposium on U.S. Earth Satellite Program - Vanguard of Outer Space, held at IRE National Convention, New York, Mar.19-22,1956). Institute of Radio Engineers, Proceedings, v.44,

RESEARCH USES, STUDIES, AND INSTRUMENTATION
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no.6, pt.1, June 1956, p.744-777. IRE Convention Record, pt.1, 1956, p.99-102. (CN-45812, pt.1)

RELATIVISTISCHE ZEITDILATION EINES KUNSTLICHEN SATELLITEN. (German). F. Winterberg. Astronautica Acta, Mar.1956, p.25-29. A study of time dilatation could be made by comparing two quartz-clocks with molecule resonance lines, one installed on the artificial satellite and the other on the surface of the earth.

AN ANALOGUE COMPUTER FOR THE VERTICAL ROCKET LANDING AND TAKE-OFF PROBLEMS. C.A. Cross. Journal of the British Interplanetary Society, v.15, no.1, Jan.-Feb. 1956, p.7-17.

INSOLATION OF THE UPPER ATMOSPHERE AND OF A SATELLITE. P.R. Gast. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.73-84. (523.1 V26)

ELECTROMAGNETIC PROPAGATION STUDIES WITH A SATELLITE VEHICLE. Fred B. Daniels. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.276-282. (523.1 V26)

A SATELLITE EXPERIMENT TO DETERMINE THE DISTRIBUTION OF HYDROGEN IN SPACE. T.A. Chubb, H. Friedman, and J. Kupperian. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.152-156. (523.1 V26)

A LAYMAN ALPHA EXPERIMENT FOR THE VANGUARD SATELLITE. T.A. Chubb, H. Friedman, and J. Kupperian. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.147-151. (523.1 V26)

IONOSPHERIC STRUCTURE AS DETERMINED BY A MINIMAL ARTIFICIAL SATELLITE. Warren W. Berning. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.253-262. (523.1 V26)

PROPOSED MEASUREMENT OF SOLAR STREAM PROTONS. Willard H. Bennett. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.194-197. (523.1 V26)

RESEARCH USES, STUDIES, AND INSTRUMENTATION
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EXPLORING THE ATMOSPHERE WITH A SATELLITE-BORNE MAGNETOMETER. E.H. Vestine. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A.Van Allen, 1956, p.198-214. (523.1 V26)

COSMIC-RAY OBSERVATIONS IN EARTH SATELLITES. James Alfred Van Allen. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.171-187. (523.1 V26)

ON THE DETERMINATION OF AIR DENSITY FROM A SATELLITE. Lyman Spitzer, Jr. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.99-108. (523.1 V26).

VISIBILITY FROM A SATELLITE AT HIGH ALTITUDES. V.J. Stakutis and Joseph X. Brennan. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27, 1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.137-146. (523.1 V26)

METEOROLOGICAL MEASUREMENTS FROM A SATELLITE VEHICLE. W.G. Stroud and W. Nordberg. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientifici Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.119-132. (523.1 V26)

PRESSURE AND DENSITY MEASUREMENTS THROUGH PARTIAL PRESSURES OF ATMOSPHERIC COMPONENTS AT MINIMUM SATELLITE ATTITUDES. H.S. Sicinski, N.W. Spencer, and R.L. Boggess. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.109-118. (523.1 V26)

MEASUREMENTS OF THE EARTH'S MAGNETIC FIELD FROM A SATELLITE VEHICLE. Siegfried Fred Singer. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27, 1956). Scientific Uses of Earth Satellites, edited by James A.Van Allen, 1956, p.215-233. (523.1 V26)

UPPER ATMOSPHERE ROCKET RESEARCH PANEL; SCIENTIFIC USES OF EARTH SATELLITES, edited by James A. Van Allen. (10th meeting, held at University of Michigan, Jan.26-27, 1956). (523.1 V26)

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METEOROLOGICAL MEASUREMENTS FROM A MINIMUM SATELLITE VEHICLE. Siegfried Fred Singer. Maryland U. Jan.14,1956. Optical measurements from a satellite are examined in the visible range, in the infrared, and in the ultraviolet (for obtaining the altitude distribution of ozone). First discussed are some problems connected with the satellite itself, its orbit and its orientation, and its instrumentation. Some of the applications to important meteorological problems are also discussed. (CN-52548)

STUDY OF FINE STRUCTURE AND IRREGULARITIES OF THE IONOSPHERE WITH ROCKETS AND SATELLITES. Wolfgang Pfister. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.283-291. (523.1 V26)

MINIMUM EARTH SATELLITE AS "STORM PATROL". Siegfried Fred Singer. (Upper Atmosphere Rocket Research Panel, 10th anniversary Meeting, Ann Arbor, Jan.26-27, 1956). Scientific Monthly, Aug. 1957, pp.95-98. Description of the use of a photocell for obtaining meteorological data from a satellite vehicle.

GEOMAGNETIC INFORMATION POTENTIALLY AVAILABLE FROM A SATELLITE. Ludwig Katz. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.247-252. (523.1 V26)

SATELLITE DRAG AND AIR-DENSITY MEASUREMENTS. L.M. Jones and F.L. Bartman. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27, 1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.85-98. (523.1 V26)

TEMPERATURE AND ELECTRON-DENSITY MEASUREMENTS IN THE IONOSPHERE BY A LANGMUIR PROBE. Gunnar Hok, H.S. Sicinski, and N.W. Spencer. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.263-267. (523.1 V26)

SATELLITE GEOMAGNETIC MEASUREMENTS. J.P. Heppner. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.234-246. (523.1 V26)

A SATELLITE PROPAGATION EXPERIMENT. L.M. Hartman and R.P. Haviland. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites,

RESEARCH USES, STUDIES, AND INSTRUMENTATION
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edited by James A. Van Allen, 1956, p.268-275. (523.1 V26)

GEOPHYSICAL AND ASTROPHYSICAL INFORMATION FROM AN INERT SATELLITE. Fred L. Whipple. Jan.25,1956. Institute of Aeronautical Sciences. Smithsonian Astrophysical Observatory.

POSSIBILITY OF USING ARTIFICIAL EARTH SATELLITES FOR THE EXPERIMENTAL VERIFICATION OF THE THEORY OF GENERAL RELATIVITY. V.L. Ginzburg. Zhurnal Experimental'noi i Teoreticheskoi Fisiki, Jan.,1956, pp.213-214. Soviet Physics - JETP, Aug.1956, pp.136-138. Translation.

SOLAR INSTRUMENTATION. J.W. Evans and R.B. Dunn. Smithsonian Contributions to Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.5-8. (CN-53300, v.1, no.1)

THE USES OF ARTIFICIAL SATELLITE VEHICLES, I. H.E. Canney, Jr., and F.I. Ordway, III. Astronautica Acta, Fasc.4,1956, p.147-174. Applications of space stations to the field of scientific inquiry, presenting the astronomical and astrophysical advantages of such a program.

SCIENTIFIC ASPECTS OF THE SATELLITE PROGRAM. W.H. Pickering. American Rocket Society Preprint 288-56. (1956). (CN-42622)

GEOPHYSICAL RESEARCH WITH ARTIFICIAL RESEARCH WITH ARTIFICIAL EARTH SATELLITES. Siegfried Fred Singer. Advances in Geophysics, H.E. Landsberg, editor. Academic Press Inc., 1956, v.3, p.301-367. (551.5 Ad9 v.3). University of Maryland Tech. Rept.53. Features discussion of individual geophysical experiments, applications of satellite results to large problems and limitations of satellite applications imposed by design characteristics.

INSTRUMENTATION COMPONENTS (OF A SATELLITE). John E. Kirk and Lester R. Grobe. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

1955

COSMIC-RAY EXPERIMENTS WITH A PROTON VELOCITY SELECTOR. K.W. Ogilvie. Canadian Journal of Physics, v.33, Dec.,1955, p.746-756.

SCIENTIFIC USES OF ARTIFICIAL EARTH SATELLITE. Homer E. Newell, Jr. Jet Propulsion, v.25, no.12, Dec.1955, p.712-713. Listing of things which can be done in

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research; satellite attempts to differentiate between those experiments which can be carried out in first small "birds" and those experiments which will probably have to await further development of engineering techniques; pictorial outline reviews near term possibilities in fields of geophysics and astrophysics.

MAN-MADE SATELLITE; NEW TOOL FOR SCIENTIFIC RESEARCH. Homer E. Newell, Jr. and Charles De Vore. Signal. (Jour. of Armed Forces Communications and Electronics Assoc.), v.10, no.2, Nov.-Dec. 1955, p.17-19, 90. Value of an uninstrumented satellite, the instrumented satellite as a radio-relay station, and the comparative value of a satellite and a rocket as data collecting devices.

SATELLITE AND ROCKET EXPLORATION EXPLORATION OF THE OUTER ATMOSPHERE. Joseph Kaplan. American Rocket Society, Chicago, Nov.16, 1955.

SCIENTIFIC OBJECTIVES AND OBSERVING METHODS FOR A MINIMUM ARTIFICIAL EARTH SATELLITE. L.G. deBey, W.W. Berning, D. Reuyl and H.M. Cobb. Ballistic Research Labs., Aberdeen Proving Ground. Rept.956. Oct.1955. (CN-44543)

THE EARTH FROM SPACE. Scientific American, v.193, no.3, Sept.1955, p.109-112. Photographs exposed in a rocket at a height of 143.4 miles, which for all practical purposes is outside the earth's atmosphere.

SCIENTIFIC USE OF AN ARTIFICIAL SATELLITE. Hildegard Korf Kallmann and William Welch Kellog. Rand Corp. RM-1500. The importance of a man-made satellite, circling the earth for a period of time for the purpose of making scientific observations, has been studied. About a dozen major scientific topics have been discussed for which valuable information can be obtained only from an artificial satellite. The uses of this information in the solution of scientific problems are described. Their applications to practical problems like radar and communication are indicated. Auxiliary requirements of altitude control, sensing devices, and telemetering equipment are investigated. (CN-47392)

EXTRA-TERRESTRIAL OBSERVATORIES - THEIR PURPOSE AND LOCATION. C.A. Cross. Journal of the British Interplanetary Society, v.14, no.3, May-June 1955, p.137-143. Progress of astronomy is greatly impeded by Earth's atmosphere, gravitation and rotation in space; 800-in. telescope in space would be capable of detecting solar systems like ours up to 20 light years away; construction of large parabolic mirrors in space is discussed, and it is suggested that they may be

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made from thin aluminized diaphragms of thermoplastic material.

APPLICATION OF SATELLITE VEHICLE. R.P. Haviland. American Rocket Society Paper 264-55. (CN-47346). Jet Propulsion, May 1956, pp.360-363, 368. Introduction to the possibilities and problems of the "inward-looking" ("inward" from the satellite, toward the earth) fields, covering weather charting, cartography and communication techniques.

STUDIES OF A MINIMUM ORBITAL UNMANNED SATELLITE OF THE EARTH (MOUSE). I - GEOPHYSICAL AND ASTROPHYSICAL APPLICATIONS. Siegfried Fred Singer. Astronautica Acta, no.4, 1955, p.171-184. American Rocket Society Paper 195-55. (CN-49372). It is the purpose of the present paper to present a strong justification for the establishment of a minimum artificial satellite of the earth in terms of the advances it would lead to in our knowledge of the earth's outer atmosphere, of extra-terrestrial radiations, and of their influence on the earth.

1954

ON THE UTILITY OF AN ARTIFICIAL UNMANNED EARTH SATELLITE; A PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION, PREPARED BY THE ARS SPACE FLIGHT COMMITTEE, Nov.24, 1954. Jet Propulsion, Feb.1955, p.71-78. App.A. Astronomical observations from a satellite. Ira S. Bowen. App.B. Biological experimentation with an unmanned temporary satellite. Hermann J. Schaefer. App.C. Satellite vehicle and physics of the earth's upper atmosphere. Homer E. Newell, Jr. App.D. Comments concerning meteorological interests in an orbiting unmanned space vehicle. Eugene Bollay. App.E. The geodetic significance of an artificial satellite. John O'Keefe. App.F. Orbital radio relays. John R. Pierce.

OBSERVING WEATHER FROM SATELLITE VEHICLE. Harry Wexler. Journal of the British Interplanetary Society, v.13, no.5, Sept.1954, p.269-282.

GEODETIC SIGNIFICANCE OF A MINIMUM SATELLITE VEHICLE. I.M. Levitt. Fifth International Astronautical Congress, Innsbruck. Aug.5-7, 1954, p.255-261. 1. Determine large distances across the surface of the Earth which are difficult to measure. This would furnish the basic tool for large scale triangulation; 2. Determine the gravitational constant "g". This would be an average g for the entire Earth; 3. Determine the oblateness of the Earth. This vehicle, which might better be called a beacon would circle the Earth at an altitude of 200 miles and reflect sunlight to

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the Earth. To an observer on the Earth it would appear brighter than a first magnitude star. Photography of the moving beacon would furnish the necessary data to compute an orbit and then use the orbit to determine the above characteristics.

IAF: UTOPIA OR REALITY? G.A. Partel. Fifth International Astronautical Congress. Innsbruck, Aug.5-7,1954, p.248-254. The author proposes to win the broadcasting and telecasting companies of the Earth for the construction of a small space station which could be destined exclusively for broadcasting and telecasting purposes. (N-46768)

EXPLORATION OF THE UPPER ATMOSPHERE WITH AUTO PROPULSION ENGINES AND THE FRENCH PROGRAM FOR THE INTERNATIONAL GEOPHYSICAL YEAR. 1957-1958. (L'EXPLOARTION DE LA HAUTE ATMOSPHERE AVEC LES ENGINS AUTOPROPULSES ET LE PROGRAMME FRANCAIS DE L'ANNEE GEOPHYSIQUE INTERNATIONALE 1957-1958). (French text). E. Vassy. Fifth International Astronautical Congress, Innsbruck. Aug.5-7, 1954. p.221-225. (N-46768).

ORBITS FOR AN EXTRA-TERRESTRIAL OBSERVATORY. C.A. Cross. Journal of the British Interplanetary Society, v.13, no.4, July 1954, p.204-207. It is unlikely that telescopes can be built on the Earth's surface very much larger than the 200-in. Hale reflector. In a free orbit many of the constructional limitations are removed, but the structure must be shielded from solar radiation. This may be achieved by putting the telescope in an outer Lagrangian equilibrium point, with a planet between it and the Sun. In certain circumstances the Sun is then permanently eclipsed. Not all the planets are suitable for this purpose.

SOME PROBLEMS IN GEODETIC MISSILES. (QUESITI SUI SUI MISSILI GEODETICI). G. Arturo Crocco. L'Aerotecnica, v.34, no.2, Apr.1954, p.59-71. Possibility of military use of orbital stations.

INVESTIGATION OF THE SOLAR CORONA BY MEANS OF ROCKETS. From: Rocket Exploration of the Upper Atmosphere. Siegfried Fred Singer. Pergamon Press, Ltd., and Interscience Publishers, 1954.

ASTROPHYSICAL MEASUREMENTS FROM AN ARTIFICIAL EARTH SATELLITE. Siegfried Fred Singer. R.L.F. Boyd and M.J. Seaton, ed. Rocket exploration of the upper atmosphere, London, Pergamon Press, 1954. Part VII, p.368-370. Considers various types of observations which might be made from an artificial satellite.

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1953

L'ASTRONAUTICS. Antonio Eula. Paper presented at a conference held in Rome, May 16,1953, of the Societa Geografica Italiana. L'Aerotecnica, v.33, no.3, June 1953, p.231-244. Discusses satellites as relay stations, military weapons, as stepping stones to space, etc.

COSMIC RAY ALTIMETER TYPE 1: GENERAL DESCRIPTION. (Preliminary copy). James Alfred Van Allen and John W.B. Barghausen. Includes Patent 2,573,823: Altimeter actuated by cosmic rays, Nov.6,1951. Johns Hopkins Univ., Applied Physics Lab., Silver Spring, Md. Feb.17,1953, 18p. (N-21773)

SOLAR WORK AT HIGH ALTITUDES FROM ROCKETS. R. Tousey. The Sun, ed. by G. P. Kuiper. University of Chicago Press, 1953.

HIGH ALTITUDE ROCKET RESEARCH. Homer E. Newell, Jr. Academic Press, 1953. A comprehensive review of the methods used and results obtained in the American high-altitude research program utilizing transformed German V-2 rockets for scientific exploration of the upper atmosphere. (551.5-N42)

1952

MARTIAN PROBE. Eric Burgess and C.A. Cross. Journal of the British Interplanetary Society, v.12, no.2, Mar.1953, p.72-74. Aeronautics, v.27, no.4, Nov.1952, p.26-33. Projection of automatic rocket into orbit around Mars, from which it would telemeter data back to earth. Such rocket requires little more development of techniques than would be needed for establishment of automatic earth satellites; data which could be collected are shown to justify proposal.

ASTRONOMY FROM THE SPACE STATION. Fred Lawrence Whipple. (Lecture given at the Second Symposium on Space Travel at the Hayden Planetarium, American Museum of Natural History, Oct.13,1952). Journal of the British Interplanetary Society, v.12, no.1, Jan.1953, p.1-3. Discusses possible observation from and uses of a space station.

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(Also satellite test apparatus) - Continued

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METHODS AND VEHICLES FOR RESEARCH IN THE HIGH ATMOSPHERE. James Alfred Van Allen, Chairman. (Discussion of papers by various authors). Proceedings of a symposium on the physics and medicine of the upper atmosphere held at San Antonio, Texas, Nov.6-9, 1951. University of New Mexico Press, 1952, p.394. (629.13256 P56)

CONCEPTION OF AN INSTRUMENT-CARRYING ORBITAL ROCKET. A.M. Kunesch. Journal of the British Interplanetary Society, v.10, no.3, May 1951, p.115-123.

FILM MOLDING AND PHOTOGRAPHIC ACCESSORIES FOR THE SUPER-SCHMIDT METEOR CAMERAS. Philip Carroll, Richard E. McCrosky, Robert C. Wells, and Fred Lawrence Whipple. Harvard Coll. Observatory. Tech. Rept.8. 1951. (N-14002)

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USE OF THE SPACE STATION FOR SPACE NAVIGATION. Lewis J. Grant, Jr. Chicago Rocket Society, Collection Tech. Repts., v.4, 1953, p.16. Journal of Space Flight, v.2, no.3, Mar. 1950, p.1-5. Describes the essential uses of a satellite in space, such as a refueling base, repair station, etc.

THE PROPER MILITARY USE OF A SPACE STATION. Wayne Proell. Chicago Rocket Society, Collection Tech. Repts., v.4, 1953, p.20. Journal of Space Flight, v.2, no.3, Mar. 1950, p.5-8. Jamming, observation, and propaganda possibilities of a space station.

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THE SPACE STATION AS A RADIO RELAY. W.T. Moore. Chicago Rocket Society, Collection Tech. Repts., v.3, 1951, p.53. Journal of Space Flight, v.1, no.6, Nov.1949, p.1-4. Discusses commercial exploitation of space stations.

MILITARY OBJECTIVES OF SPACE FLIGHT. W.T. Moore. Chicago Rocket Society, Collection Tech. Repts., v.3, 1951, p.13. Journal of Space Flight, v.1, no.2, July 1949, p.1-3. The space-station as a miliary observation post, storage center, psychological warfare center, etc.

PLANETARY PHOTOGRAPHY IN THE ULTRAVIOLET AND INFRARED. J.C. Turner. Bulletin of the British Interplanetary Society, v.2, no.1, 1947.

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MAGNETIC FIELD METER (DESIGN, APPLICATIONS, AND THEORY OF THE INSTRUMENT). A.G. Kalashnikov. Zhurnal Teknicheskoi Fiziki, v.13, no.7-8,1943, p.407-422. Translation. Construction of an instrument for vectorial measurement of the intensity of an

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inhomogeneous magnetic field, based on the measurement of current produced in the circuit of a small rotating coil are described. (CN-56269)

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RESULTS FROM EXISTING ARTIFICIAL SATELLITES

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ARTIFICIAL SATELLITES OF THE EARTH. Wireless World, v.63, Dec.1957, p.574–578 (appears as abstract in Proceedings of the IRE, v.46, no.3, Mar.1958, p.680). Extracts are given from Radio, Moskow published before the launching of the USSR satellites (see, e.g., 3860 of 1957 (Vakhnin)) and results of observations made at various stations in the U.K. are summarized.

UNUSUAL PROPAGATION AT 40 MC FROM THE USSR SATELLITE. H. W. Wells. (Received by the IRE, Jan.9,1958. Results given here were reported at a meeting of the Washington Academy of Sciences, Dec.19,1957). Proceedings of the IRE, v.46, no.3, Mar.1958, p.610.

THE LAST DAYS OF SPUTNIK I. John D. Kraus. Proceedings of the IRE, v.46, no.3, Mar.1958, p.612–614.

A NOTE ON SOME SIGNAL CHARACTERISTICS OF SPUTNIK I. John D. Kraus and J. S. Albus. Proceedings of the IRE, v.46, no.3, Mar. 1958, p.611.

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UPPER ATMOSPHERE DENSITIES FROM MINITRACK OBSERVATIONS ON SPUTNIK I. I. Harris and R. Jastrow. Science, v.127, no.3296, Feb.28, 1958, p.471–472.

BASIC ORBITAL DATA FOR SATELLITE 1957 BETA ONE. Luigi G. Jacchia. Feb.21,1958. Smithsonian Institution Astrophysical Observatory, Special Rept.9. (CN–59408 Spec. Rept.9)

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A PHOTOGRAPHIC OBSERVATION OF THE SATELLITE 1957 BETA LEAVING THE EARTH'S SHADOW. Heinz Neckel. Nature, v.181, no.4604, Jan.25, 1958, p.257–258.

SOVIET ORBIT INFORMATION FOR USSR SATELLITES 1957 ALPHA 2 AND BETA 1. G. F. Schilling. Smithsonian Institution Astrophysical Observatory Special Rept.8. Jan.31,1958. (CN–59408 Spec.Rept.8)

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VISUAL OBSERVATIONS OF ALPHA ONE MADE BY MOONWATCH STATIONS DURING LIFETIME OF THE OBJECT. Leon Campbell, Jr. and J. A. Hynek. Smithsonian Institution Astrophysical Observatory Special Rept.6. Dec.17,1957. (CN–59408 Spec.Rept.6)

SOVIET ORBIT PREDICTIONS AND ORBITAL INFORMATION FOR USSR SATELLITES 1957 ALPHA ONE, ALPHA TWO, AND BETA. G. F. Schilling and E. S. Fergusson. Smithsonian Institution Astrophysical Observatory Special Rept.5. Dec.4,1957. (CN–59408 Spec.Rept.5)

ARTIFICIAL SATELLITES OF THE EARTH. Wireless World, Dec.1957, p.574–578. Study of observations by radio of the first transmitted signals beyond the ionosphere.

OBSERVATIONS OF SATELLITE I. Fred Lawrence Whipple and Joseph Allen Hynek. Scientific American, v.197, no.6, Dec.1957, p.37–43. How a group of U.S. astronomers plotted the orbit of the first Soviet satellite.

SOME PRELIMINARY VALUES OF UPPER ATMOSPHERE DENSITY FROM OBSERVATIONS OF USSR SATELLITES. T. E. Sterne and G. F. Schilling. Smithsonian Institution Astrophysical Observatory Special Rept. 3. Nov.15,1957. (CN–59408 Spec. Rept.3)

ROCKET OF THE FIRST EARTH SATELLITE: (SPUTNIK I). Nature, v.180, no.4593, Nov.9,1957, p.944. Brief comments and photographs by the Dunsink Observatory, Ireland.

FURTHER RADIO OBSERVATIONS OF THE FIRST SATELLITE. (SPUTNIK I). Nature, v.180, no.4593, Nov.9,1957, p.943–944. Compilation of data from Univ. of Ill. Observatory, Marconi's Wireless Telegraph Co., Ltd. and Ministry of Supply.

RADAR OBSERVATIONS OF THE FIRST RUSSIAN EARTH SATELLITE AND CARRIER ROCKET. (SPUTNIK I): By the Staff of the Jodrell Bank Experimental Station, Univ. of Manchester. Nature, v.180, no.4593, Nov.9,1957, p.941–942.

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ADDITIONAL ORBIT INFORMATION FOR USSR SATELLITES 1957 ALPHA ONE AND BETA ONE. John S. Rinehart and G. F. Schilling. Smithsonian Institution Astrophysical Observatory Special Rept.2. Nov.5,1957. (CN–59408 Spec.Rept.2)

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RADIO OBSERVATIONS OF THE RUSSIAN EARTH SATELLITE. (SPUTNIK I). By the Staff of the Mullard Radio Astronomy Observatory, Cambridge. Nature, v.180, no.4592, Nov.2,1957, p.879–883.

RADIO–SIGNAL RECEPTION FROM THE SATELLITE "SPUTNIK I". (Intercettazione di segnali radio emessi dal satellite "Sputnik I"). Pier Francesco Checcacci, Vera Russo and Cesare Carreri. La Ricerca Scientifica, v.27, no.11, Nov.1957, p.3252–3260. (Italian text). Pulse signals have been recorded, and examined with an oscilloscope. Oscilloscope patterns and signal records are shown. When pulses ceased and a continuous wave was sent, the variations of the radial velocity were evaluated from Doppler's effect.

ORBIT MEASUREMENTS OF AN ARTIFICIAL EARTH SATELLITE (SPUTNIK II) FROM PHOTOGRAPHS TAKEN WITH A TRACKING BALLISTIC TELESCOPE SYSTEM. Dirk Reuyl. Ballistic Research Labs., Aberdeen Proving Ground. Tech.Note 1156. Nov.1957. A brief resume is given of optical methods for the measurement of artificial earth satellites. Observations of the third stage rocket of Sputnik I and Sputnik II with tracking ballistic telescope systems, based on SMT and IGOR instruments, are described. Measurements were made of Sputnik II records obtained with the SMT system during the dawn passage on Nov.7, 1957. (CN-57267)

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ORBIT OF THE ARTIFICIAL EARTH SATELLITE. Nature, v.180, no.4590, Oct.19,1957, p.784. Gives detailed orbit calculations.

PRELIMINARY ORBIT INFORMATION FOR USSR SATELLITES ALPHA ONE AND ALPHA TWO. G. F. Schilling and T. E. Sterne. Smithsonian Institution Astrophysical Observatory Special Rept.1. Oct.14,1947. (CN–59408 Spec.Rept.1)

RUSSIAN SATELLITE TRANSMITS SOME DATA. Aviation Week, v.67, no.15, Oct.14,1957, p.27.

NEW ZEALAND VISUAL OBSERVATIONS OF THE ROCKET ACCOMPANYING THE RUSSIAN ARTIFICIAL SATELLITE. R. A. Anderson and C. S. L. Keay. Astronautica Acta, v.3, no.4, 1957, p.227–230.

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ENVIRONMENTAL SPACE - METEORS (Natural and man-made)

1958

PREDICTION OF CRATERING CAUSED BY METEOR IMPACTS. Maury Kornhauser, General Electric. American Astronautical Society, Annual meeting, New York, Jan. 29-31,1958. Data from high-speed laboratory experiments, explosive craters, and meteorite impacts are correlated to obtain an approximate expression for depth of penetration in terms of target material properties and kinetic energy of the impacing particle.

ARGON-POTASSIUM AGES AND THE ISOTOPIC COMPOSITION OF ARGON FROM METEORITES. Johannes Geiss and David C. Hess. Astrophysical Journal, v.127, no.1, Jan.1958, p.224-236. The potassium and the argon contents of 13 meteorites were measured by the isotopic dilution method. It is proved that the amounts of A^{36} and A^{38} found in these samples are of extraterrestrial origin, the main source being spallation processes induced by cosmic radiation. In some chondrites an excess of A^{36} compared to A^{38} was found. Possible sources for this A^{36} are discussed. The 7 chondrites measured give ages between 4.4×10^9 years and 4.0×10^9 years. The ages of achondrites vary between 4.4×10^9 and 0.7×10^9 years.

METEOR HAZARDS BEYOND THE ATMOSPHERE. M.W. Ovenden. (In Space Research and Exploration, edited by D.R. Bates). 1958. (629.1388 B31)

1957

METEORITES CONFERENCE IN MOSCOW. Nature, v.180, no.4598, Dec.14, 1957, p.1325. A brief report on the 7th Meteorite conference, held in Moscow towards the end of 1956, is published by E.L. Krinov (Priroda, no.7, 57; 1957). A full report will appear in the journal Meteoritica.

NEUMANN BANDS IN STONY-IRON METEORITES. Robert R. O'Neil and John S. Rinehart. Smithsonian Institution. Tech.Rept.6. Dec.12, 1957. (CN-59163)

ORIGIN OF DEEP ELLIPSOIDAL PITS ON LARGE IRON METEORITES. Robert R. O'Neil and John S. Rinehart. Smithsonian Institution. Tech. Rept.5. Dec.12,1957. (CN-59162)

ARTIFICIAL METEORS. Nature, v.180, no.4596, Nov.30,1957, p.1168. Artificial meteors in the form of aluminum pellets were released by an Aerobee rocket at an altitude of 54 miles over New Mexico on Oct.16. Some of the meteors may have achieved speeds in excess of the velocity of escape from the Earth's gravitational field.

IMPACT EFFECTS AND TEKTITES. John S. Rinehart. Smithsonian Institution. Tech.Rept.2. Oct.30,1957. (CN-59161)

ENVIRONMENTAL SPACE - METEORS (Natural and man-made) - Continued

METEOR JUNIOR, A PRELIMINARY DESIGN INVESTIGATION OF A MINIMUM SIZED FERRY ROCKET VEHICLE OF THE METEOR CONCEPT. Darrell C. Romick, Richard E. Knight and Samuel Black. (Presented at 8th International Astronautics Congress, Barcelona, Oct.7-12,1957). American Rocket Society, Preprint 504-57. (CN-59137)

THE METEORITIC RISK TO SPACE VEHICLES. Fred Lawrence Whipple. (Presented at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957). American Rocket Society, Paper 499-57. A table of data and probabilities that surfaces in space in the neighbourhood of the earth may be punctured by meteoric action is given. It is calculated that a near-earth satellite of radius 20 in. and aluminum skin thickness of 0.5 mm. will be punctured on the average of once in 5 days. Upper limits to the combined effects of skin erosion by meteoric dust, corpuscular radiation from the sun, and gases of the extended solar corona are estimated to be of the order of 2×10^{-13} g./cm^2./sec. or less. This would not functionally affect optical surfaces exposed to space over periods less than a year. (CN-57904)

EFFECT OF COSMIC-RAY RADIATION ON IRON METEORITES. (UBER DIE EINWIRKUNG DER HOHENSTRAHLUNG AUF EISENMETEORITE). (German) K.H. Ebert and H. Wanke. Zeitschrift fur Naturforschung, v.12a, no.10, Oct.1957, p.766-773.

OBSERVATIONS ON ABLATION AND METALLURGICAL EFFECTS PRODUCED BY SURFACE HEATING OF THE ALGOMA METEORITE. Robert R. O'Neil. Smithsonian Institution Scientific Rept.1. Aug.26,1957. (CN-56806)

METEORIC DUST EROSION PROBLEM AND ITS EFFECT ON THE EARTH SATELLITE. Stuart A. Hoenig. Aeronautical Engineering Review, July 1957, p.37-40. Review of recent experiments on penetration and other work in the field, and discussion of the effects of meteoric impact. Includes a projection of future research plans.

DYNAMICAL LIMITS ON A LUNAR ORIGIN FOR TEKTITES. Carlos M. Varsavsky. (Paper presented at Conference on the Problems of Tektites held under auspices of National Academy of Sciences, June 17-18,1957). Smithsonian Institution Tech.Rept.4. Theories regarding the origin of tektites are reviewed and it is proposed that the moon is the most likely source for these objects. Detailed calculations show that the Whipple-Rhinehart model for the ejection of tektites from the moon makes it possible to reproduce their observed distribution over the earth's surface. (CN-58172)

METEOR DISTRIBUTION AND CRATERING. John Sargent Rinehart. (Paper presented at Hypervelocity and Impact Effects Symposium held at Naval Research Lab., May 22-24,1957). Smithsonian Institution Tech. Rept.3. This paper discusses the nature and distribution of meteoric particles (interplanetary

dust, meteors and meteoroids, and meteorites) and some of the physical aspects of penetration mechanics. (CN-58173)

METEORS AND SPACEFLIGHT. H.H. Langton. Spaceflight, v.1. no.3, Apr.1957, p.92-100.

THE EROSION OF METEORS AND HIGH-SPEED VEHICLES IN THE UPPER ATMOSPHERE. C. Frederick Hansen. NACA TN 3962. Mar.1957. Analytic relations for velocity deceleration, size, and relative magnitude of luminosity of meteors are derived in parametric form. Comparison of the theory with observed meteor behavior indicates that a large fraction of the atmospheric bombardment energy is used in eroding meteor material. Erosion from large, high-speed vehicles in free-molecule flow is calculated and the mass loss is found negligible.

GROUND SIMULATION OF METEORITIC DUST IMPACT ON HIGH FLYING VEHICLES. Donald H. Robey. Convair-Astronautics. 1957. A general discussion of meteoritic dust is presented and deductions pertaining to the physical properties and probable speeds are given. A hypothesis to explain the rainfall correlation with meteor showers is also included. Finally a proposal for accelerating dust particles to speeds of 30 kilometers per second is discussed. (CN-52100)

1956

ON METEOR ECHOES FROM UNDERDENSE TRAILS AT VERY HIGH FREQUENCIES. Morton Loewenthal. Lincoln Lab., Massachusetts Inst. of Tech. Rept.132. Dec.13,1956. The cylindrical model for a weakly ionized meteor trail leads to a $(\text{wave length})^3$ dependence in the reflected power and a $(\text{wave length})^2$ in the duration of the echo. This report analyzes the behavior of the echo in the frequency range where the time of trail formation is important. (CN-56899)

METEORIC ABRASION STUDIES PROPOSED FOR VANGUARD. Martin Jay Swetnick. Proceedings of the 3rd American Astronautical Society, Dec.6-7, 1956, p.59-64. One of the uses Vanguard satellites will be put to is a study of the effect of meteoric impact on the skin of the satellite. Meteoric impacts will have an abrasive effect which will result in the erosion of the satellite skin. Two methods of studying meteoric abrasion of satellite skins have been approved for inclusion in the program. (N-58942)

A PRELIMINARY INVESTIGATION OF FLARING AND ABLATION OF HIGH-SPEED PELLETS. Emerson T. Cannon, William S. Partridge and Charles R. Whited. Utah U. Interim Tech. Rept.4. Dec.1956. A value of 0.38 for the drag coefficient of small cylinders was calculated using experimental results. The minimum velocity at which flaring will occur

was determined using pellets or various materials and with different presentation areas being accelerated by smooth bore guns and explosives. (N-53128)

THE EFFECT OF METEORIC PARTICLES ON A SATELLITE. Siegfired Fred Singer. Jet Propulsion, v.26, no.12, Dec.1956, p.1071-1075. American Rocket Society Paper 307-56. Analysis of some physical models to allow calculation of the erosion rate on space vehicles. These studies lead to widely differing values, and it is concluded that laboratory experiments with artifically accelerated dust particles would furnish more reliable guides for a theory. 20 references. (CN-49371)

SOME NEW DATA ON HIGH-SPEED IMPACT PHENOMENA. J.H. Hugh, J.S. Thompson and M.E. Van Valkenburg. American Society of Mechanical Engineers. Paper 56-A-15. Nov.25-30,1956. (CN-54516)

TIME LAG OF IONIZATION BEHIND ULTRA-SPEED PELLETS. R.A. Davidson and William S. Partridge. Utah U. Interim Tech. Rept.6. Aug.1956. (N-47827)

THE RELATIONSHIP BETWEEN VELOCITY AND THE IONIZATION ASSOCIATED WITH EXPLOSIVELY-PROPELLED ALUMINUM PELLETS. L. Dale Harris and William S. Partridge. Utah U. Interim Tech.Rept.5. July 1956. (CN-46177)

THE IMPACT THEORY OF THE ORIGIN OF LUNAR CRATERS. John James Gilvarry and Jerald Everett Hill. Astronomical Society of the Pacific, Publications, v.68, no.402, June 1956, p.223-229. The purpose of this paper is to present the results of computations on the pressures and temperatures attained in the impact of large meteorites on the lunar surface, based on the equation of state as obtained from the Thomas-Fermi statistical model of the atom. (CN-58028)

WAX MODELLING STUDIES OF HIGH-SPEED IMPACT. Wallace G. Clay and William S. Partridge. Utah Univ. June 1956. (N-58632)

PRELIMINARY OBSERVATIONS OF FORWARD SCATTERING OF ELECTROMAGNETIC WAVES BY METEOR TRAILS. H.J. Wirth. Navy Electronics Lab., Rept.690. May 9,1956. The problem is to develop communication equipment which will make use of the scattering of electromagnetic waves from the ionized trails of meteors to achieve distant transmission. (CN-45482)

THE IMPACT OF LARGE METEORITES. John James Gilvarry and Jerald Everett Hill. Rand Corp. P-836. Apr.3,1956. The impact of large meteorites on the moon or earth is discussed, on the basis of a one-dimensional idealization of the flow problem, in which a plane shock wave in both meteorite and impact surface is considered. Conditions are discussed under which such a model can yield physically

valid estimates of pressure and temperature generate on explosive impact of meteorites. (CN-57820)

IMPACT PHENOMENA AT HIGH SPEEDS. M.E. Valkenburg, Wallace G. Clay and John Harvey Huth. Utah U. Feb.15,1956. Metal-to-metal impact characteristics in the velocity range 1-5 mm per sec is described. Several experiments relating to the mechanisms of cratering, including the perforation of thin targets are presented. For 1/8 inch diameter spherical pellets the volume of the crater per unit energy of the impacting pellet is essentially constant and the penetration is proportional to the velocity of the pellet. An attempt to model very high speed impact by means of soft wax targets in which the sonic velocity is less than the impacting velocity is outlined. (N-52957)

METEORIC BOMBARDMENT. Maurice Dubin. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.292-300. (523.1 V26)

MEASUREMENTS OF INTERPLANETARY DUST. Siegfried Fred Singer. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27, 1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.301-316. (523.1 V26)

EXPERIMENTS FOR MEASURING TEMPERATURE, METEOR PENETRATION, AND SURFACE EROSION OF A SATELLITE VEHICLE. Herman E. Lagow. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.68-72. (523.1 V26)

AN APPLICATION OF LEAST-SQUARES TO THE DETERMINATION OF THE SUB-END POINT OF A METEOR. John A. Russell. Meteoritics, v.1, no.4, 1956, p.399-402.

THE VELOCITIES OF SPORADIC METEORS. Charles P. Olivier. Meteoritics, v.1, no.4, 1956, p.389-393.

ON THE CLASSIFICATION SEQUENCE OF METEORITES AND THE SUBCLASSES OF THE HEXAHEDRITES. Frederick C. Leonard. Meteoritics, v.1, no.4, 1956, p.438-440.

EFFECT OF THE PASSAGE OF BRIGHT METEORS ON RADIO-RECEPTION. Yu. N. Khlystov. Byul(letin) Vago, no.10, p.37-38, 1956. English trans. by Air Technical Intelligence Center ATIC 242106. (CN-53932)

PHOTOGRAPHIC STUDY OF METEORS BY THE MOSCOW SECTION OF THE ALL-UNION ASTRONOMICAL GEODETIC SOCIETY IN 1949-1950. N.I.Grishin and K.A. Mansurova. Byul(letin) Vago, no.10, p.19-27, 1956. English trans. by Air Technical Intelligence Center ATIC 242106. (CN-53932)

MAGNITUDES OF SPORADIC AND PERSEID METEORS. Sidney van den Bergh.

ENVIRONMENTAL SPACE - METEORS (Natural and man-made) - Continued

Meteoritics, v.1, no.4, 1956, p.395-398.

ATTENUATION OF THE PHOTOGRAPHIC IMAGE OF A METEOR AS A FUNCTION OF ITS ANGULAR VELOCITY. D.L. Astavin-Razumin. Byul(letin) Vago, no.10, p.42-44, 1956. English trans. by Air Technical Intelligence Center ATIC 242106. (CN-53932)

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PROBLEMS OF SPACE DEBRIS WITH THE SATELLITE STATION. Wayne Proell. Journal of Space Flight, v.7, no.10, Dec.1955, p.1-4.

A NEW APPROACH TO PENETRATION MECHANICS. J.H. Huth, J.S. Thompson and M.E. Van Valkenburg. Rand Corp. P-746. Oct.6,1955. (CN-57817)

RADAR DETERMINATION OF METEOR SHOWERS IN SOUTHERN HEMISPHERE. C.D. Ellyett and K.W. Roth. Australian Journal of Physics, v.8, no.3, Sept.1955, p.390-401. Survey made in 1953 showing radiants calculated from daily range-time plots of meteor echoes; many major meteor showers are found to lie closely on plane of ecliptic. Bibliography.

TRANSIENT HEAT CONDUCTION IN COMPOSITE SLABS FOR A HEAT FLUX VARYING EXPONENTIALLY WITH TIME. C. Gazley, J.H. Huth and M.C. Horn. Rand Corp. RM-1524. July 22,1955. (N-41110)

A STUDY OF THE IONIZATION PRODUCED BY ULTRA-SPEED PELLETS. Charles D. Hendricks, Jr. Utah U. Tech. Rept.3. June 1,1955. A method of accelerating conical metal or plastic pellets by explosives techniques to velocities up to 4.5 km/sec is described. (CN-44996)

THE PHYSICAL THEORY OF METEORS. VII - ON METEOR LUMINOSITY AND IONIZATION. Fred Lawrence Whipple. Astrophysical Journal, v.121, no.1, Jan.1955, p.241-249. (CN-52756)

SYMPOSIUM ON METEOR PHYSICS. (Journal of Atmospheric and Terrestrial Physics, v.2, Special suppl., 1955).

HEAT TRANSFER AND THE ABLATION PROCESS IN METEORS. R.N. Thomas. Journal of Atmospheric and Terrestrial Physics, v.2, special suppl., p.1-7, 1955. A summary is given of conclusions and essential details of attempts to collate data from meteor observations and laboratory investigations on artificial meteors, in order to investigate heat transfer and ablation in the astroballistic regime. (N-41795)

ON THE VELOCITIES AND ORBITS OF METEORS, FIREBALLS, AND METEORITES. Fred L. Whipple and Robert F. Hughes. Journal of Atmospheric and Terrestrial Physics, v.2, special suppl., p.149-156, 1955. (CN-41794)

THE NATURE OF METEORIC RADIATION. Allen F. Cook. Journal of

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Atmospheric and Terrestrial Physics, v.2, special suppl., p.8-15, 1955. (CN-41793)

1954

A METHOD FOR PRODUCING HIGH VELOCITY METALLIC AND PLASTIC PELLETS. M.E. Van Valkenburg and Charles D. Hendricks, Jr. Utah U. Tech. Rept.2. Oct.15,1954. (CN-54985)

THE VULNERABILITY OF SATELLITE VEHICLES TO COUNTER-MEASURES. L.H. Thomas. Jet Propulsion, v.24, no.5, Sept.-Oct.1954, p.321-322. Vulnerability of a satellite to fine shot traveling in a counter orbit.

MECHANICAL PENETRATION OF BUMPER SCREENS. N.H. Langton. Journal of British Interplanetary Society, v.13, no.5, Sept.1954, p.283-294. Penetration of screens of different materials, particularly aluminum, by iron or stone meteorite, investigated theoretically; tables and graphs showing penetrations for different sized meteorites at varying impact velocities; values compared with those for thermal penetrations; conclusions about design of bumper screens and space hulls.

THE THERMAL DISSIPATION OF METEORITES BY BUMPER SCREENS. N.H. Langton. Fifth International Astronautical Congress, Innsbruck. Aug.5-7,1954, p.72-80. Heat which is generated at the point of meteoritic collision with a bumper screen is spread through a hemispherical volume of the screen. Thicknesses of screens penetrated by various meteoritic sizes and collision velocities are calculated. Results are given for iron and stone meteorites, and general penetration equations derived which can be applied to screens of various metals.

QUANTITATIVE ESTIMATE OF FREQUENCY AND MASS DISTRIBUTION OF DUST PARTICLES CAUSING THE ZODIACAL LIGHT EFFECT. Hildegard Korf Kallmann. (Presented at 6th International Astrophysical Symposium, July 1954). Rand Corp. P-542. An estimate of the number of meteors and the amount of meteoric dust entering the earth's atmosphere per day was made. From the number distribution as a function of radii derived by Van de Hulst for the zodiacal light effect, a comparison between meteoric dust and zodiacal dust has been made for particles having radii between .025 and .0001 centimeters. (CN-57819)

HIGH-ALTITUDE WINDS BY METEOR-TRAIN PHOTOGRAPHY. William Liller and Fred L. Whipple. Rocket exploration of the upper atmosphere. Journal of Atmospheric and Terrestrial Physics, 1954, p.112-130. (N-33498)

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THE PHYSICAL THEORY OF METEORS. IV - INQUIRY INTO THE RADIATION PROBLEM - A LABORATORY MODEL. R.N. Thomas and W.C. White. Astrophysical Journal, v.118, Nov.1953, p.555-567.

RESEARCHES ON THE PHYSICAL THEORY OF METEOR PHENOMENA. I. THEORY OF THE FORMATION OF METEOR CRATERS. Ernst Öpik. Acta et Commentationes Universitatis Tartuensis. (USSR). TP 28. May 1953. (N-42798)

THE PHOTOGRAPHIC PERSEID METEORS. Frances W. Wright and Fred L. Whipple. Harvard Coll. Observatory, Tech.Rept.11. 1953. (N-23961)

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THE FORMATION OF CRATERS BY HIGH-SPEED PARTICLES. Norman Rostoker. (Presented at 15th meeting of Meteoritical Society, Albuquerque, N.M., Sept.2-4, 1952). Meteoritics, New Mexico U. Publication Series, p.11-27. (N-42799)

THE MECHANISM OF RADIO REFLECTIONS FROM METEORIC IONIZATION. Von Russell Eshleman. Electronics Research Lab., Stanford U. Tech.Rept.49. July 15,1952. Theory is developed for radio reflections from columns of ionization with cylindrical symmetry. Characteristics of radio echoes from meteor trails are explained by the application of this theory. (CN-58567)

THE PHYSICAL THEORY OF METEORS. III - Conditions at the Meteor Surface. R.N. Thomas. Astrophysical Journal, v.116, July 1952, p.203-210.

METEORIC IONIZATION. Peter M. Millman. Air Force Cambridge Research Center, Geophysical Research Paper 11. Apr.1952. (N-16613)

A COMPARATIVE ANALYSIS OF ATMOSPHERIC DENSITIES FROM METEOR DECELERATIONS OBSERVED IN MASSACHUSETTS AND NEW MEXICO. Luigi G. Jacchia. Harvard Coll. Observatory. Tech.Rept.10. 1952. (N-20396)

METEORS AS PROBES OF THE UPPER ATMOSPHERE. Fred Lawrence Whipple. Compendium of Meteorology, p.356-365, 1952. (N-11948)

DISCOVERY OF METEORIC DUST AT THE PLACE OF FALL OF THE SIKHOTE-ALIN SHOWER OF IRON METEORITES. E.L. Krinov and S.S. Fonton. Translation from Akademiia Nauk SSSR, Doklady, v.85, no.6, p.1227-1230, 1952. (CN-52817)

OUT OF THE SKY: INTRODUCTION TO METEORITES. Harvey Harlow Nininger. Sage Publisher, 1952 and Burns and Maceachern, Toronto.

RESEARCH IN STONE-DROPPING METEORS. C.C. Wylie. Univ. of Iowa, Tech. Repts. (N-23610 and N-23690)

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METEOROIDS, METEORITES, AND HYPERBOLIC METEORITIC VELOCITIES. Lincoln LaPaz. Proceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9,1951.

ENVIRONMENTAL SPACE - METEORS (Natural and man-made) - Continued

University of New Mexico Press, 1952, p.331-393. (629.13256 P56)

METEORITIC PHENOMENA AND METEORITES. Fred Lawrence Whipple. (Proceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9,1951). University of New Mexico Press, 1952, p.137-170. Discusses meteoritic penetration of high-altitude vehicles, chances of meteoritic encounter, masses and energies of meteoroids, the problem of penetration of a high-velocity meteoritic particle into a solid metallic surface and safety precautions. (629.13256 P56)

THE PHYSICAL THEORY OF METEORS. II - ASTROBALLISTIC HEAT TRANSFER. R.N. Thomas and F.L. Whipple. Astrophysical Journal, v.114, Nov.1951, p.448-465. (N-14004)

METEOR-HAZARDS TO SPACE STATIONS. Michael W. Ovenden. Second International Congress on Astronautics, held in London by British Interplanetary Society, Sept.3-8,1951. The analysis of Grimminger is summarized, and possible astronomical factors affecting its validity examined. For space-station life-times of more than one year, it is concluded that either a heavily-armoured hull or a "meteor bumper" will be required.

RESULTS OF ROCKET AND METEOR RESEARCH. Fred Lawrence Whipple. (Presented at Symposium on Upper Atmosphere at assembly of Internat. Union of Geodesy and Geophysics, Brussels, Aug.1951). American Meteorological Society, Bulletin, v.33, no.1, Jan.1952, p.13-25. (N-16457)

THE PHYSICAL THEORY OF METEORS. I - A REACTION-RATE APPROACH TO THE RATE OF MASS LOSS IN METEORS. M.A. Cook, H. Eyring and R.N. Thomas. Astrophysical Journal, v.113, May 1951, p.475-481. (N-14005)

PHENOMENA ASSOCIATED WITH FLIGHT OF ULTRA-SPEED PELLETS. W. Allen, J. Rinehart and W. White. Journal of Applied Physics, v.23, Jan.1951, p.132-137. Journal of Applied Physics, v.23, Mar.1951, p.297-299.

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METEORS AND SPACE TRAVEL. Michael W. Ovenden. Journal of the British Interplanetary Society, v.10, 1951, p.176.

THE EVASION OF HAZARDOUS OBJECTS IN SPACE, PARTS I AND II. Wayne Proell. Chicago Rocket Society, Collection Tech.Repts., v.5, 1953, p.20 and 26. Journal of Space Flight, v.3, 1951.

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METEOR AND SPACE TRAVEL. G. Dirognet. Journal of the British

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METEORS AS A DANGER TO SPACE-FLIGHT. Arthur Charles Clarke. Journal of the British Interplanetary Society, v.8, no.4, July 1949, p.157-162. Concludes they are real dangers but easily neutralized by simple means.

THE METEOR PROBLEM AND SPACE SHIP DESIGN. Wayne Proell. Chicago Rocket Society, Collection Tech. Repts., v.2, 1951, p.35. The Rocket News Letter, v.2, no.6, Jan.1949.

A PHENOMENOLOGICAL THEORY OF RADIO ECHOES FROM METEORS. D.W.R. McKinley and P.M. Millman. Proceedings of the Institute of Radio Engineers, v.37, p.364, 1949.

METEORS AS OBJECTIVES IN A LUNAR FLIGHT. Wayne Proell. Chicago Rocket Society, Collection Tech. Repts., v.1, 1949, p.26. The Rocket News Letter, vol.1.

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PROBABILITY THAT METEORITE WILL HIT OR PENETRATE BODY SITUATED IN VICINITY OF EARTH. G. Grimminger. Journal of Applied Physics, v.19, no.10, Oct.1948, p.947-956. For meteorites which are large enough to present a perforation hazard, the probability of a hit is negligibly small ...

CHARACTERISTICS OF RADIO ECHOES FROM METEOR TRAILS. I. THE INTENSITY OF THE RADIO REFLECTIONS AND ELECTRON DENSITY IN THE TRAILS. A.C.B. Lovell and J.A. Clegg. Proceedings of the Physical Soc., Series A, v.60, p.491, 1948.

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HARVARD METEOR PROGRAM; PURPOSE, PLANS, STATUS AND PRELIMINARY RESULTS, MARCH 1947, CAMBRIDGE, MASS. Fred Lawrence Whipple. Harvard College Observatory, Technical Report 1. Report of a program to determine the trajectories, velocities, decelerations of meteors by the two-camera method and to investigate the ballistics of projectiles moving at velocities from 12 to 72 km/sec in a rarefied atmosphere.

THE NATURE AND DISTRIBUTION OF METEORIC MATTER. M.W. Ovenden. Journal of the British Interplanetary Society, v.6, 1947, p.157-173.

RADAR OBSERVATIONS OF METEORS. J.S. Hey and G.S. Stewart. Proceedings of the Physical Society, v.59, p.858, 1947.

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THE THEORY OF METEOR IONIZATION. N. Herlofson. Physical Society, Reports on Progress in Physics, v.11, 1946-1947, p.444-454. (CN-59190)

VELOCITIES, ORBITS AND MASSES OF METEORITES. (SKOROSTI, ORBITY I

MASSY METEORITOV). B. Yu Levin. Air Technical Intelligence Center. ATIC 262877. 1946. Astronomicheskii Zhurnal, v.23, no.2, p.83-95, 1946. Translation. The physical theory of meteors as well as the observational data show that the velocity does not play a smaller part than the mass but, if anything, a more important part. Allowance for the role of the velocity permits characterizing the typical properties of the orbits of meteoric bodies and estimating the part of the meteoric matter that is vaporized during its flight. (CN-54381)

(ON METEORS AND THEIR RESULTANT IONIZATION). Lovell. Physical Society Reports of Progress in Physics, v.11, p.415, 1946.

POSSIBLE HAZARDS TO A SATELLITE VEHICLE FROM METEORITES. Rand Corp. 1946.

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WHISTLING METEOR - A DOPPLER EFFECT PRODUCED BY METEORS ENTERING THE IONOSPHERE. Chamanlal and K. Venkalamaran. Electrotechnics, v.14, p.28, 1941.

(ON METEORS AND THEIR RESULTANT IONIZATION). Pierce. Physical Review, v.59, p.625, 1941.

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ATOMIC COLLISIONS AND RADIATION OF METEORS. Ernst Öptik. Harvard U. Reprint 100. 1933. Only relatively small meteors are considered in this paper. Collisions of meteor atoms with air molecules represent the chief source of radiation. A method is developed for calculating the amount of visible radiation produced by a meteor of given velocity, mass, and chemical constitution. (CN-51783)

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1958

ON THE STRUCTURE OF EXTENSIVE COSMIC RAY AIR SHOWERS: LATERAL STRUCTURE OF THE IONIZING COMPONENT. E. W. Kellermann, T. Shaw and G. O. Walker. Proceedings of the Physical Society, v.71, pt.3, no.459, Mar.1,1958, p.491-496.

RECENT ADVANCES IN REAL GAS EFFECTS IN HYPERSONIC FLOW. Wayland C. Griffith. Jet Propulsion, v.28, no.3, Mar.1958, p.157-159. At high altitudes the atmosphere is so rarefied that the equations of continuum mechanics no longer hold, while the temperature produced by hypersonic flight through the lower atmosphere is sufficient to dissociate and ionize air molecules. This article describes recent progress in our understanding of these effects. The bibliography is not intended to be at all complete, but is selected to serve as a guide to literature on the subject.

EMISSION LINES IN THE EXTREME ULTRAVIOLET SPECTRUM OF THE SUN. F. S. Johnson, H. H. Malitson, J. D. Purcell and R. Tousey. Astrophysical Journal, v.127, no.1, Jan.1958, p.80-95.

ULTRA-HIGH-ALTITUDE AERODYNAMICS. Samuel A. Schaaf, Lawrence Talbot and Lee Edson. Scientific American, v.198, no.1, Jan.1958, p.36-42. At low altitudes the air streaming past a flying object behaves as a true fluid, but at altitudes above 40 miles the object is struck by individual atoms and molecules. (GN-58872)

OXYGEN RED LINES IN THE AIRGLOW. I - TWILIGHT AND NIGHT EXCITATION PROCESSES. II - COLLISIONAL DEACTIVATION EFFECTS. Joseph W. Chamberlain. Astrophysical Journal, v.127, no.1, Jan.1958, p.54-74.

THE DESTRUCTIVE EFFECT OF SOLAR CORPUSCULAR RADIATION ON SMALL PARTICLES. John A. Wood, Jr. Astrophysical Journal, v.127, no.1, Jan.1958, p.241-242 (Notes section).

ON THE USE OF THE EARLY BALMER LINES TO EXTEND THE PHOTOSPHERIC MODEL. R. G. Athay and R. N. Thomas. Astrophysical Journal, v.127, no.1, Jan.1958, p.96-107.

THE KINETIC TEMPERATURE OF AN ATMOSPHERE SUPPORTED BY RADIATION - II. Alvin H. Davis. Astrophysical Journal, v.127, no.1, Jan.1958, p.118-124. The anisotropy of the kinetic temperature of a tenuous atmosphere in an anisotropic radiation field is investigated. The atmosphere is supposed to consist of small particles capable of continuous absorption and emission and assumed to be in pseudo-thermostatic equilibrium. Interparticle collisions are assumed to be of negligible importance. A numerical evaluation of the anisotropy is given for the case of an atmosphere above a surface radiating as a black body.

COSMIC RADIATION AND SPACE-FLIGHT. L. R. Shepherd. (In Space Research Exploration, edited by D. R. Bates), 1958. (629.1388 B31)

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SOME CHARACTERISTICS OF THE UPPER ATMOSPHERE PERTAINING TO HYPER-VELOCITY FLIGHT. C. Frederick Hansen. Jet Propulsion, v.27, no.11, Nov.1957, p.1151-1156. The chemical processes which occur in the air are discussed relative to their effects on the density and temperature structure of the atmosphere. The reactions responsible for most of the solar energy absorption are outlined along with the major rate controlling reactions which determine the atmosphere's state of chemical equilibrium. It is demonstrated that because of the low density most of the aerodynamic force and heat transfer effects become secondary above 60 miles altitude for vehicles traveling at speeds up to escape velocity.

A POSSIBLE SOLAR EFFECT ON WIND PATTERNS AT HIGH ALTITUDES. David D. Woodbridge, Theodore W. Pohrte and Norman Macdonald. High Altitude Observatory. Tech. Rept. 4, Nov.1957. There is considerable evidence that the earth intercepts, from time-to-time, streams of electrified particles from the sun. A qualitative survey of weather maps showed that disturbances of the earth's magnetic field, presumably under impact from solar particle emission, were followed in 4 to 10 days by major disturbances in the wind flow parterns at 30,000 ft. These disturbances developed into unusual high altitude weather patterns and resulted in disruptions of the jet stream and development of pronounced low pressure troughs. They finally work their way down to the ground and result in increased storminess at the earth's surface. (CN-57789)

AN INVARIANT GRAVITATIONAL DENSITY. J. L. Synge. Proceedings of the Royal Irish Academy, v.58, sect.A, no.4, Oct.30,1957, p.29-39. (CN-57177)

INVESTIGATION OF THE COMPOSITION OF PRIMARY COSMIC RAYS. S. N. Vernov, V. L. Ginzburg, L. V. Kurnosova, L. A. Razorenov and M. I. Fradkin. (Presented at Conference on Earth Satellites, Washington, D.C., Oct.2-5,1957). U.S. Joint Publications Research Service, Rept.187, p.190-213. Translation from Uspekhi Fizicheskikh Nauk, v.63, no.1a, Sept.1957, p.131-148. (N-58836, pt.1)

ANTI-GRAVITY. A. R. Weyl. Aeronautics, v.37, no.2, Oct.1957, p.80-82,85-86. A sober comment on a subject leading to fantastic possibilities.

ATMOSPHERIC DRAG ON THE SATELLITE. R. Jastrow and C. A. Pearse. Journal of Geophysical Research, v.62, Sept. 1957, p.413-423. Drag results from collisions with neutral air particles and from losses associated with the passage of a charged sphere through an ionized medium.

TRANSPORT PROPERTIES OF IONIZED GASES IN A MAGNETIC FIELD. Marshall N. Rosenbluth. (Presented at ARS-Northwestern U. 2nd Biennial Gas Dynamics Symposium, Aug.26-28,1957). American Rocket Society Paper 484-57. (N-54847)

ENVIRONMENTAL SPACE - EARTH - Continued

THE SIMULATION OF GRAVITY. Derek F. Lawden. Journal of the British Interplanetary Society, v.16, no.3, July-Sept.,1957, p.134-140. Comparison of the artificial gravitational field produced by rotating a spaceship or artificial satellite about its own axis with normal gravity at the Earth's surface.

THE BALANCING OF THE GRAVITY FIELD. R. A. Hirvonen. Mapping and Charting Research Lab., Ohio State U. Research Foundation. Tech. Paper 716-3, July, 1957. (CN-58578)

A STUDY OF SOME TEMPORAL VARIATIONS OF THE GEOMAGNETIC FIELD FROM AN ANALYSIS OF SELECTED OBSERVATORY DATA. J. A. Jacobs. Toronto U., June 30, 1957. (CN-59368)

RECENT DEVELOPMENTS IN HYPERSONIC FLOW. Lester Lees. (Presented at ARS Semi-annual meeting, San Francisco, Calif., June 10-13, 1957). Guggenheim Aeronautical Lab., Calif. Inst. of Tech. Publication 428. Jet Propulsion, v.27, no.11, Nov.1957, p.1162-1178. (N-54022X)

PREPARATION OF MUTUALLY CONSISTENT MAGNETIC CHARTS. P. Fougere and J. McClay. Cambridge Research Center, Geophysical Research Paper No.55, June 1957, 39p. Development of an analytic method for preparing magnetic charts of the earth. (CN-56362)

JET STREAMS IN THE EARTH'S ATMOSPHERE. J. S. Sawyer. Symposium on Planetary Atmospheres and Convection in Rotating Fluids, under sponsorship of Royal Meteorological Soc. and Royal Astronomical Soc., held in London during May 23-24,1957. Summary in Nature, v.180, no.4600, Dec.28,1957, p.1459.

THEORY OF THE GENERAL CIRCULATION OF THE ATMOSPHERE. J. G. Charney. Symposium on Planetary Atmospheres and Convection in Rotating Fluids, under sponsorship of Royal Meteorological Soc. and Royal Astronomical Soc. and Royal Astronomical Soc., held in London during May 23-24, 1957. Summary in Nature, v.180, no.4600, Dec.28,1957, p.1459-1460.

THE GENERAL CIRCULATION OF THE EARTH'S ATMOSPHERE. P. A. Sheppard. Symposium on Planetary Atmospheres and Convection in Rotating Fluids, under sponsorship of Royal Meteorological Soc. and Royal Astronomical Soc., held in London during May 23-24,1957. Summary in Nature, v.180, no.4600, Dec.28,1957, p.1456.

EXPERIMENTAL PLAN AND INSTRUMENTATION FOR THE DETERMINATION OF THE ELECTRON DENSITY IN THE IONOSPHERE. INCLUDES: DETERMINATION OF THE ELECTRON DENSITY IN THE IONOSPHERE. Obed C. Haycock. (Covers period June 1, 1952 to Apr.30,1957). Upper Air Research Labs., U. of Utah Scientific Rept.1, May 21,1957. The primary purpose was the study of electron densities and their spacial distribution in the ionosphere. Sounding rockets are used as vehicles for part of the

equipment. The report describes the plan of the experiment and the equipment used. Pages 109-129 are a final report on the program. (CN-56897)

ELECTRON DENSITY DISTRIBUTION IN A NEW MODEL OF THE IONOSPHERE. H. K. Kallmann. Rand Corp. P-1089. May 15,1957. The purpose of this presentation is to give a brief outline of the theoretical analysis which has led to a new model of the ionosphere, to present the results which have been obtained, and to compare the theoretical results with the direct observations - in particular with observations obtained by means of research rockets. (N-52040X)

MOLECULAR APPROACH TO PROBLEMS OF HIGH-ALTITUDE, HIGH-SPEED FLIGHT. G. N. Patterson. University of Toronto Institute of Aerophysics, UTIA Review No. 10, May 1957, p.65. Effects of rarefaction and high temperatures on the flow of gases are considered. The regimes of fluid mechanics based on those considerations and the modern experimental methods for their investigations are discussed.

ATMOSPHERIC TRANSMISSION OF STARLIGHT AND SOLAR INTENSITY OBSERVATIONS. Roger Hosfeld and J. Allen Hynek. Ohio State U. Research Foundation Proj. RF 583, May 1957. (CN-59364)

ELECTRO-GRAVITICS: WHAT IT IS -- OR MIGHT BE. A. V. Cleaver. Journal of the British Interplanetary Society, v.16, no.2, Apr.-June, 1957.

COSMIC RAYS IN SPACE. H. Victor Neher. Astronautics Symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. Cosmic rays contain about a half a percent of lithium, beryllium and boron, about the same abundances of these elements as for carbon, nitrogen and oxygen. Relative to ordinary stellar cosmic abundances there are more of the heavier nuclei. This presents a theoretical problem and, in terms of space travel, we are interested in these heavy nuclei with high energies, which can do a great deal of damage.

SOLAR X-RAYS AND THE IONOSPHERE. Herbert Friedman. Astronautics symposium, held in San Diego, Feb. 18-20,1957, under sponsorship of Office of Scientific Res. and Convair. E region is largely formed by the x-rays of wavelengths from 10 to 100 angstrom units and energy distribution seems to resemble a gray body at a temperature of something of the order of 700,000 degrees.

RECENT STUDIES OF THE ATMOSPHERE AND IONOSPHERE BETWEEN 90 AND 300 KM. Hildegard Korf Kallmann. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. First successful effort to reconstruct theoretically the ionospheric electron content. As a basis, rocket data for the

incoming solar radiation equilibrium conditions in the high atmosphere, including various methods for removing the electrons was used. She has developed a theoretical ionosphere good to nearly 300 km, consistant with the observations as we know them.

COSMIC BOOMERANG. G. Chebotarev. Rand Corp. RM-1922, p.173-177. Translation from Znanie-Sila, v.32, no.2, Feb.1957, p.28-29. (CN-47550, pt.2)

A PRELIMINARY SURVEY OF THE FIELD OF ULTRAVIOLET RADIATION. Donald Keith Berkey and Ruth Silverman. Rome Air Development Center TR 57-26, Feb.1957. This report presents a discussion of research accomplished in the ultraviolet (uv) field. The methods used to explore the near, intermediate, and far uv regions are examined, and upper atmosphere investigations are covered, as are various methods of measuring wavelengths. (CN-56274)

A UNIFIED THEORY OF GENERAL RELATIVITY OF GRAVITATION AND ELECTROMAGNETISM. PART IV. Luther P. Eisenhart. Proceedings of the National Academy of Sciences of the USA, v.43, 1957, p.333-336. In this paper the author derives in a different manner the results of part III of the same subject.

A NEW METHOD FOR INTERPRETATION OF AEROMAGNETIC MAPS: PSEUDO-GRAVIMETRIC ANOMALIES. V. Baranov. Geophysics, v.22, 1957, p.359-382; discussion, p.382-383.

NOTES ON THE SOLAR CORONA AND THE TERRESTRIAL IONOSPHERE. Sydney Chapman. Smithsonian Contributions to Astrophysics, v.2, no.1, 1957. This paper discusses the following: outward thermal conduction from the solar corona; statical equilibrium of the model corona; mean free path, collision frequency and collision interval for the electrons; possible influence of the solar magnetic field; how the coronal gas affects a non-magnetic planet; zodiacal dust; influence of the coronal gas upon the outermost atmosphere of the earth; and the temperature of the outer ionosphere. (CN-53300, v.2, no.1)

SIZE AND SHAPE OF THE EARTH. W. A. Heiskanen, Editor. Institute of Geodesy, Photogrammetry and Cartography of the Ohio State University, 1957, p.107. A symposium at Ohio State University on Nov.1956. Covers classic and modern arc measuring methods; celestial and gravimetric methods; world gravimetric and geodetic system.

THE ATMOSPHERES OF THE EARTH AND PLANETS. Gerard P. Kuiper, editor. Univ. of Chicago Press, 1957. (523.4 K95 1952)

THE PLANET EARTH. Simon and Schuster, New York, 1957, 168p. A comprehensive picture of current knowledge about the earth's interior and crust, its waters, atmosphere, and nearby cosmic environment.

ENVIRONMENTAL SPACE - EARTH - Continued

1956

PRINCIPAL DIRECTIONS OF CURRENT RESEARCH ACTIVITY IN THE THEORY OF GRAVITATION. Bryce S. DeWitt. Proceedings of the 3rd American Astronautical Society, New York, Dec.6-7,1956, p.157-168. Two broad problems in the field of gravitation are discussed, namely, the relationship of gravitation to all other phenomena of nature as electro-magnetism, quanta, etc., and what are the underlying physical concepts. A brief review is made of the current world-wide effort by academic and industrial organizations in support of gravitational research. (N-58942)

THE CIRCULATION OF THE ATMOSPHERE. Victor P. Starr. Scientific American, v.195, no.6, Dec. 1956, p.40. The sun's heat and the earth's rotation together produce the prevailing winds.

THE ENVIRONMENT OF AN EARTH SATELLITE. Rosemary Griffith, W. Nordberg and William Graham. Signal Corps Engineering Labs. Tech. Memo. M-1747, Mar.30,1956; Nov.15,1956. (rev.), (2nd edition). This report is an effort to collect in a single volume the basic data relating to the satellite environment during both the launching and the in-orbit phases. It is a collection of graphs, tables, and other data. (CN-54380)

SEARCH FOR SMALL EARTH SATELLITES. Clyde William Tombaugh. (For period: 1953-56). Physical Science Lab., New Mexico Coll., Oct.1,1956. A search for small natural satellites of the earth has been in progress at Flagstaff, Arizona since 1953, sponsored by Army Ordnance. This is a description of the history and progress of the satellite search, written for the information of those people who may be interested in knowing how the work was and is being conducted, and to acquaint them with some of the interesting problems that unfold as the work progressed. (CN-48123)

HIGH-MACH AERODYNAMICS. Leon Trilling. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

THE ENVIRONMENT (OF A SATELLITE). Leon Trilling. Taken from: Orbital and Satellite Vehicles, v.1 & v.2. Edited by Paul E. Sandorff, Massachusetts Institute of Technology, 1958. (This is a Chapter from the book which is a compilation of notes for an undergraduate course in orbital and satellite vehicles originally given in the Summer of 1956, but being compiled into above book).

PROCEEDINGS OF THE POLAR ATMOSPHERE SYMPOSIUM, PART II. (Held at Oslo, July 2-8,1956). Journal of Atmospheric and Terrestrial Physics,

Special Suppl., 1957. Contents: Theoretical views on drift measurements, by I. L. Jones. Drift of an ionized layer in the presence of the geomagnetic field, by K. Weekes. Height-variation of horizontal drift velocities in the E-region, by I. L. Jones. Results of ionospheric drift measurements in the United States, by Vaughn Agy. Results of ionospheric drift measurements in Norway, by Leiv Harang. Large-scale movements of the layers, by H. W. Wells. Movements of ionospheric irregularities observed simultaneously by different methods, by I. L. Jones, B. Landmark and C. S. G. K. Setty. Measurements of irregularities and drifts in the Arctic ionosphere using airborne techniques by George J. Gassmann. Turbulence in the ionosphere with applications to meteor trails, radio star scintillation, auroral radar echoes, and other phenomena, by H. G. Booker. Electron distribution in a new model of the ionosphere, by H. K. Kallmann. Prediction techniques at high latitudes, by J. H. Meek. Geographic distribution of geophysical stations on the polar cap, by A. H. Shapley. Statistical results and their shortcomings concerning the ionosphere within the auroral zone, by R. W. Knecht. Polar disturbances, by J. H. Meek. Polar blackout occurrence patterns, by Vaughn Agy. Quantitative measurements of absorption in the auroral zone, by F. Lied. Forecasting of disturbed HF communication conditions, by R. C. Moore. Spectrum of the electron density fluctuations in the ionosphere, by Roger M. Gallet. A theory of long-duration meteor-echoes based on atmospheric turbulence with experimental confirmation, by H. G. Booker and Robert Cohen. Some implications of slant-E, by E. K. Smith and R. W. Knecht. Results of scatter measurements at 36 Mc/s over a 1200 km path, by Tor Hagfors.

THE THRESHOLD OF SPACE. M. Zelikoff. (Proceedings of the Conference on Chemical Aeronomy. Sponsored by AF Cambridge Research Center, held at Cambridge, Mass., June 25-28, 1956). Pergamon Press, 1957. (551.5 Z3)

AERODYNAMICS AT VERY HIGH ALTITUDES. S. A. Schaaf. Jet Propulsion, v.26, no.4, Apr.1956, p.247-250. Research results in the Berkeley low density supersonic wind tunnel are described, covering a range of flow conditions corresponding to flight at altitudes up to eighty miles.

HOW BRIGHT IS THE EARTH? Alan E. Slater. Journal of the British Interplanetary Society, v.15, no.2, Mar.-Apr.1956, p.91-94. Of total sunlight falling on Earth, 4/10th is reflected back into space. This is expressed by saying that the Earth's albedo is 0.40. Danjon's estimate of 0.40 is made by measuring the earth-light when the Moon is being lit by that hemisphere of the Earth in which Paris is situated. But the other side of the Earth is believed less cloudy, and therefore

less bright, so he estimates the average albedo of the Earth as only 0.36.

PHYSICAL PROPERTIES OF THE ATMOSPHERE FROM 90 TO 300 KILOMETERS. H. K. Kallmann, W. B. White and H. E. Newell, Jr. Rand Corp. P-833. Feb.1956. This model is consistent with or depends on the following assumptions: Molecular oxygen begins to dissociate appreciably only above 90 km; at around 130 km about 30 percent of O_2 is still in the undissociated state; molecular nitrogen begins to dissociate above 220 km; the concentration of molecular oxygen and nitrogen decreases with altitude exponentially; the temperature becomes isothermal in the region of the exosphere, approximately above 360 km. All physical quantities have been calculated from self-consistent equations as continuous functions of altitude, without assuming any particular form of the temperature gradient. The results show lower temperatures and densities throughout the region of the ionosphere than have been deduced previously. (CN-52616X)

QUANTITATIVE INTENSITY MEASUREMENTS IN THE EXTREME ULTRAVIOLET. H. E. Hinteregger. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A Van Allen, 1956, p.166-170. (523.1 V26)

THE RADIATIVE HEAT TRANSFER OF PLANET EARTH. Jean I. F. King. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.133-136. (523.1 V26)

STUDY OF THE ARRIVAL OF AURORAL RADIATIONS. James Alfred Van Allen. (Presented at 10th meeting of Upper Atmosphere Rocket Research Panel, Univ. of Mich., Jan.26-27,1956). Scientific Uses of Earth Satellites, edited by James A. Van Allen, 1956, p.188-193. (523.1 V26)

EARTH'S MAGNETISM. Walter M. Elsasser. Smithsonian Contributions to Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.67-71. (CN-53300, v.1, no.1)

WHISTLERS. L. R. O. Storey. Scientific American, v.194, no.1, Jan. 1956, p.34. They are curious natural radio signals now discovered to be echoes of lightning.

SOLAR-TERRESTRIAL RELATIONSHIPS: WEATHER AND COMMUNICATIONS. Walter Orr Roberts. Smithsonian Contributions to Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.99-101. (CN-53300, v.1, no.1)

AIRGLOW AND AURORA. A. B. Meinel. Smithsonian Contributions to Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.95-97. (CN-53300, v.1, no.1)

ENVIRONMENTAL SPACE - EARTH - Continued

ARDC MODEL ATMOSPHERE. R. A. Minzer and W. S. Ripley. Air Force Surveys in Geophysics, no.86, 1956. The 1956 ARDC Model Atmosphere, defined and tabulated to 542,248 meters of 1,850,870 feet is designed to be used for the same purposes as a standard atmosphere. (N-53766)

PHYSICS OF FULLY IONIZED GASES. Lyman Spitzer, Jr. Interscience Publishers, 1956.

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RADIO OBSERVATIONS OF THE IONOSPHERE AT OBLIQUE INCIDENCE. J. H. Chapman, Kenneth Davies and C. A. Littlewood. Canadian Journal of Physics, v.33, Dec.1955, p.713-722.

INTERPLANETARY MAGNETIC FIELDS AND COSMIC RAYS. Levett Davis, Jr. Physical Review, v.100, Dec.1,1955, p.1440-1444.

AURORA AND AIRGLOW. C. T. Elvey and Franklin E. Roach. Scientific American, v.193, no.3, Sept. 1955, p.140. One is visible and the other is not, both give us revealing information.

THE IONOSPHERE. T. N. Gautier. Scientific American, v.193, no.3, Sept.1955, p.126-132, 134-136,138. Above the stratosphere the sparse atoms and molecules of air are disrupted by the harsher radiations of the sun. A revealing and useful property of this mantle is its reflection of radio waves.

THE ATMOSPHERE. N. C. Gerson. (Series title: Air Force surveys in geophysics, no.73). (Incl. App.: Upper atomospheric nomenclature, by S. Chapman). Air Force Cambridge Research Center TN 55-216, Sept.1955. Concerned with four fields: Auroral physics, ionospheric physics, geomagnetism, and cosmic rays. In addition the structure, composition and dynamics of the atmosphere, the ionic layers, airglow statistics, auroral statistics, and the geomagnetic field are discussed. (N-41398)

THE EARTH'S GRAVITY. Weikko A. Heiskanen. Scientific American, v.193, no.3, Sept.1955, p.164. Changes in gravity from place to place tell us the shape of our planet.

THE CIRCULATION OF THE ATMOSPHERE. Harry Wexler. Scientific American, v.193, no.3, Sept.1955, p.114. Large-scale motions of the atmosphere distribute the heat from the sun.

TURBULENCE ABOVE THE OZONE LAYER. A. E. Slater. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

TEMPERATURE PROBLEMS IN ASTRONAUTICS. L. Hansen. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

SOLAR ECLIPSES AND THE IONOSPHERE. W. J. G. Beynon and G. M. Brown, editors. (Symposium held under auspices of International Council of Scientific Unions, Mixed Commission on the Ionosphere, London, Aug.1955). International Council of Scientific Unions. (523.78 In8)

ENVIRONMENTAL SPACE - EARTH - Continued

COSMIC RAY EFFECTS ON MATTER AT HIGH ALTITUDES. Siegfried Fred Singer. (Presented at Sixth International Astronautical Congress, Copenhagen, Aug.1955).

EXTREME ATMOSPHERES AND BALLISTIC DENSITIES. Norman Sissenwine and Allen E. Cole. Air Force Cambridge Research Center TN 56-201, July 1955. A description of Artic air from the surface to 100,000 feet is presented. This atmosphere can be used as a typical sounding by designers of vertically rising vehicles or descending bombs. Variations in atmospheric density between air masses and the effect on bomb trajectories, including an example for a typical design, are discussed. (CN-47720)

AN ADJUSTABLE STANDARD ATMOSPHERE, WITH APPLICATION TO GRAVITY-PROPELLED BODIES. Ralph H. Upson. Minnesota U. RAL EM 43, May 1955. High-altitude and rarefied atmospheric research into such problems as aerodynamic drag, change of altitude, and return-to-earth of a space rocket or a satellite body, with calculations based on the fundamental assumption of constant temperature gradient within a given atmospheric layer, taking into account the theory of vertically rising or falling bodies; includes detailed measurements of drag in the troposphere and lower stratosphere.

A STUDY OF THE STRUCTURE OF THE IONOSPHERE. Hildegard Korf Kallmann. (Thesis submitted to Calif. U., Feb.1955). Rand Corp. P-638. The purpose of this investigation is to present a theoretical description of the ionized layers of the upper atmosphere in closer accord with observed results than the descriptions currently accepted. (CN-57815)

STANDARD ATMOSPHERE--TABLES AND DATA FOR ALTITUDES TO 65,800 FEET. NACA Rept. 1235 prepared by International Civil Aviation Organization of Canada and Langley Aeronautical Laboratory, 1955. The physical constants and basic equations defining the ICAO Standard Atmosphere are presented together with tables and diagrams of the properties of the ICAO Standard Atmosphere computed by the National Advisory Committee for Aeronautics in both metric and English units for altitudes from -5000 meters to 20,000 meters and from -16,500 feet to 65,800 feet.

ADVANCES IN GEOPHYSICS, VOLUME 2. H. E. Landsberg, editor. Academic Press, Inc., 1955. Contents: Advances in radar weather, by J. S. Marshall, W. Hitschfeld and K. L. S. Gunn. Methods of objective weather forecasting, by I. I. Gringorten. Wind generated gravity waves, by W. J. Pierson, Jr. Geological chronometry by radioactive methods, by J. Laurence Kulp. Earthquake seismographs and associated instruments, by Hugo Benioff. (551.5 Ad9 v.2)

ENVIRONMENTAL SPACE - EARTH - Continued

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THEORY OF ORIGIN OF COSMIC RAYS. Edward Teller. Physical Society of London. Reports on Progress in Physics, v.17, 1954, p.154-172. Primary cosmic rays consist of fast protons and heavier nuclei. Dependence of the number of cosmic rays on their energy and the relative abundance of the various nuclear species, together with the isotropic distribution of the cosmic radiation, has to be explained by any theory of cosmic rays. It is shown that a random acceleration process, proposed by Fermi, and a physical location of the accelerating fields in radio stars, proposed by Unsöld, account satisfactorily for the main features of cosmic radiation.

CONCENTRATIONS OF IONS IN A THERMALLY IONIZED GAS AS A FUNCTION OF PRESSURE. B. Timan. Akademiia Nauk SSSR, Doklady, v.97, no.6, p.1013-1014, 1954. Associated Technical Services Trans. RJ-330. (N-43629)

THE PHYSICS OF THE STRATOSPHERE. R. M. Goody. Cambridge Monographs on Physics, Cambridge U. Press, 1954. (533.3 G63)

SOLAR SYSTEM. V.2 - THE EARTH AS A PLANET. Gerard P. Kuiper, editor. Univ. of Chicago Press, 1954.

HORIZONTAL MOVEMENTS IN THE IONOSPHERE. B. H. Briggs and M. Spencer. Physical Society of London, Reports on Progress in Physics, v.17, 1954, p.245-280. The object of the paper is to survey the existing knowledge of horizontal movements in the ionosphere as obtained by radio methods.

ROCKET EXPLORATION OF THE UPPER ATMOSPHERE. R. L. F. Boyd and M. J. Seaton. London, 1954. Papers read at a conference arranged by the Upper Atmosphere Rocket Research Panel of the U.S. and Gassiot Committee of the Royal Soc. of London, held at Oxford, Aug.24-26,1953. (Contents of conference: 42 articles). (N-33498)

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ROCKET UPPER AIR RESEARCH. Homer E. Newell, Jr. and Joseph W. Siry. Journal of American Rocket Society, v.23, no.1, Jan.-Feb.1953, p.7. American Rocket Society. Paper no.62-52.

MICROMETEOROLOGY; A STUDY OF PHYSICAL PROCESSES IN THE LOWEST LAYERS OF THE EARTH ATMOSPHERE. Oliver Graham Sutton. Macmillan, 1953. (551.5 Su8)

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THE PROBLEM OF RADIATION IN SPACE. (DAS PROBLEM DER STRAHLUNG IM WELTRAUM). Karl Wiese. (German text & Eng. summary). Proceedings of the 3rd International Astronautical Congress, Stuttgart, Sept.1-6,1952, p.188-200. Radiation as well as matter has a dual nature, undulatory and corpuscular. For the radiation, typical conditions of cosmic space appear

already in relatively low altitudes. Beyond the ionosphere, the entire spectrum of solar radiation is effective. It consists not only of the visible light but also of numerous other electromagnetic waves. The electromagnetic waves and their effects are described in detail. (N-53323)

THE UPPER ATMOSPHERE. S. K. Mitra. The Asiatic Society, Calcutta, 1952.

ADVANCES IN GEOPHYSICS. VOLUME 1. H. E. Landsberg, editor. Academic Press, Inc., 1952. Contents: Automatic processing of geophysical data, by John C. Bellamy. Some new statistical techniques in geophysics, by Arnold Court. Studies of the general circulation of the atmosphere, by Bert Bolin. Exploration of the upper atmosphere by meteoritic techniques, by Fred L. Whipple. Unsolved problems in physics of the high atmosphere, by N. C. Gerson. Estuarine hydrography, by D. W. Pritchard. Earth's gravitational field and its exploitation, by G. P. Wollard. Aeromagnetic surveying, by J. R. Balsley. (551.5 Ad9 v.1)

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THE NATURE AND INTENSITY OF THE COSMIC RADIATION. James Alfred Van Allen. Proceedings of a symposium on the physics and medicine of the upper atmosphere held at San Antonio, Texas, Nov.6-9, 1951. University of New Mexico Press, 1952, p.239-266. This paper summarizes the present state of knowledge of the nature and intensity of the cosmic radiation within the Earth's atmosphere and above the atmosphere. The author has cast the known physical facts into a form which may aid definitive study of the matter. (629.13256 P56)

DISCUSSION OF PHYSICS OF THE UPPER ATMOSPHERE. Joseph Kaplan. Proceedings of a symposium on the physics and medicine of the upper atmosphere, held at San Antonio, Texas, Nov.6-9,1951, University of New Mexico Press, 1952, p.331-351. (629.13256 P56)

THERMAL ASPECTS OF TRAVEL IN THE AEROPAUSE - PROBLEMS OF THERMAL RADIATION. Konrad Buettner. Proceedings of a symposium on the physics and medicine of the upper atmosphere held at San Antonio, Texas, Nov.6-9,1951, University of New Mexico Press, 1952, p.88-98. (629.13256 P56)

ULTRAVIOLET RADIATION AND X-RAYS OF SOLAR ORIGIN. T. Robert Burnight. Proceedings of a symposium on the physics and medicine of the upper atmosphere held at San Antonio, Texas, Nov.6-9,1951, University of New Mexico Press, 1952, p.226-238. (629.13256 P56)

PHYSICS AND MEDICINE OF THE UPPER ATMOSPHERE; A STUDY OF THE AEROPAUSE. Clayton S. White and Otio O. Benson, Jr., editors. (Proceedings of a symposium held at San Antonio, Texas, Nov.6-9,1951 sponsored by Air University School of Aviation Medicine,

Randolph Field, Texas). Univ. of New Mexico Press, 1952. (629.13256 P56)

SHAPE OF COSMIC-RAY STAR-SIZE DISTRIBUTIONS IN NUCLEAR EMULSIONS. M. Birnbaum, Maurice M. Shapiro, B. Stiller and F. W. O'Dell. (Work reported at Schenectady meeting of American Physical Society, June 15, 1951). Physical Review, v.86, no.1, p.86-89, Apr.1,1952. (N-16286)

THE EARTH'S ATMOSPHERE. J. Humphries. Journal of the British Interplanetary Society, v.10, no.1, Jan.1951, p.18-26.

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THE ORIGIN OF COSMIC RADIATION. Edward Teller. Physics Today, v.2, no.8, Aug.1949, p.6-13. Cosmic ray research has been among the liveliest and most controversial subjects of pure physics in recent years. At a meeting in England last year the author submitted for discussion a theory that cosmic radiation originated within our own solar system. He explains it here.

APPLICATION OF THE THEORY OF FREE MOLECULAR FLOW TO AERONAUTICS. H. Ashley. Institute of the Aeronautical Sciences, Preprint 164, 1949.

THE EARTH'S UPPER ATMOSPHERE. D. R. Bates. Royal Astronautical Society, Monthly Notes, v.19, 1949, p.215-245.

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THEORY OF DRAG IN HIGHLY RAREFIED GASES. M. Heinemann. Communications in Pure and Applied Mathematics, v.1, no.3, Sept.1948, p.259-273.

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THE INTERNATIONAL GRAVITY FORMULA. Walter D. Lambert. American Journal of Science, v.234-A, 1945, p.360-392. (CN-58121)

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ON THE FIGURE OF THE EARTH AND MOON. H. Jeffereys. Monthly Notices of the Royal Astronominal Society, v.101, no.1, 1941, p.34.

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DETERMINATION OF LUNAR GEOMAGNETIC VARIATIONS BY THE AID OF CALCULATING MACHINES. (OPREDELENIYE LUNNYKH GEOMAGNITNYKH VARIATSIY PRI PONOSCHCHI SCHETNYKH MASHIN). A. Ya. Orlov. (Translation from Akademiia Nauk SSR, Izvestiia, Seriia Geograficheskaia i Geofizicheskaia, no.2, p.195-206, 1937). Air Technical Intelligence Center ATIC 293927. The lunar variations of terrestrial magnetism yield valuable material for the study of the physical properties of the upper layers of the atmosphere. (CN-57840)

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LUNAR FLIGHT. Robert W. Buchheim. (Lecture for course - Space Technology). University of California - Lecture 4A, Feb. 3-5,1958.

EMPLORING OUR NEIGHBOR WORLD, THE MOON. Donald Howard Menzel. National Geographic Magazine, v.113, no.2, Feb.1958, p.277-296.

A PRELIMINARY DETERMINATION OF THE POSITION OF SOME FIRST- AND SECOND-MAGNITUDE STARS ON MARS' CELESTIAL SPHERE. Frederick R. West, Jr. American Astronautical Society, Annual meeting, New York, Jan.29-31,1958.

RADAR ECHOES FROM THE MOON AT A WAVELENGTH OF 10 CM. B.S. Yaplee, R.H. Bruton, K.J. Craig, and N.G. Roman. Proceedings of the Institute of Radio Engineers, v.46, no.1, Jan.1958, p.293-297.

OCCURRENCES OF THE YELLOW CORONAL LINE. Dorothy E. Trotter. Astrophysical Journal, v.127, no.1, Jan.1958, p.75-79. Dates and heliographic locations of strong yellow coronal line emission λ 5694 are listed for observations at the High Altitude Observatory and the Sacramento Peak Observatory for Nov.8,1951, through Apr. 30,1957.

OBSERVATIONS OF MARS AND JUPITER AT A WAVE LENGTH OF 3.15 CM. C.H. Mayer, T.P. McCullough, and R.M. Sloanaker. Astrophysical Journal, v.127, no.1, Jan.1958, p.11-16. A number of observations of Mars were made with the NRL 50-foot reflector at a 3.15-cm wave length during Sept. 1956, when the planet was near opposition. Of these, 71 observations were selected for a quantitative reduction, which yielded a black-body temperature for Mars of $218^{\circ} \pm 76^{\circ}$ K (m.e.). Twenty-nine observations of Jupiter were made with the same apparatus in May 1956. A black-body temperature of $140^{\circ} \pm 56^{\circ}$ K (m.e.) was found from these data. Further observations of improved accuracy were made in Mar.1957 when Jupiter was near opposition.

OBSERVATIONS OF VENUS AT 3.15-CM WAVE LENGTH. C.H.Mayer, T.P. McCullough, and R.M. Sloanaker. Astrophysical Journal, v.127, no.1, Jan.1958, p.1-10. The observations of radiation from Venus at 3.15-cm wave length on 34 days in May-June 1956, are described. The apparent black-body temperature for Venus derived from the measurements changed from about $620^{\circ} \pm 110^{\circ}$ K (m.e.) in early May to about $560^{\circ} \pm 73^{\circ}$ K (m.e.) near inferior conjunction. Two single observations at 9.4-cm wave length are described, which suggest that the radiation follows a thermal spectrum.

EXCITATION TEMPERATURES AND TURBULENT VELOCITIES IN SUNSPOTS. Robert Howard. Astrophysical Journal, v.127, no.1, Jan.1958, p.108-117.

CONDITIONS ON THE MOON AND NEARER PLANETS. Patrick Moore. In Space

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Research and Exploration, ed. by D.R. Bates, 1958. (629.1388 B31)

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PLANETARY ATMOSPHERES AND CONVECTION IN ROTATING FLUIDS. Nature, v.180, no.4600, Dec.28,1957, p.1455-1461. A symposium on "Planetary Atmospheres and Conection in Rotating Fluids", under the joint auspices of the Royal Meteorological Society and the Royal Astronomical Society, was held in London during May 23-24, 1957. Introduction, by Harold Jeffreys. The basic observational data on planetary atmospheres, by Zdenek Kopal. The general circulation of the earth's atmosphere, by P.A. Sheppard. The circulation of the oceans, by H.U. Sverdrup. The circulation of the atmospheres of the outer planets, by E. Lorenz. Transfer processes in planetary atmospheres, by G.B. Tucker. Experiments on convection in rotating fluids, by Raymond Hide. The thermal structure of Mars, by R.M. Goody. The escape of planetary atmospheres, by H.C. Urey. The influence of condensation on planetary atmospheres, by R.C. Sutcliffe. Jet streams in the earth's atmosphere, by J.S. Sawyer. The theory of the experiments on convection in rotating fluids, by T.V. Davies. Theory of the general circulation of the atmosphere, by J.G. Charney. The physical parameters characterizing the dynamics of planetary atmospheres, by E.T. Eady.

RADIO PICTURES OF THE SUN. W.N. Christiansen, D.S. Mathewson, and J.L. Pawsey. Nature, v.180, no. 4593, Nov.9,1957, p.944-946.

A ROCKET AROUND THE MOON. Krafft A. Ehricke and George Gamow. Scientific American, v.196, no.6, June 1957, p.47-53.

THE ATMOSPHERE OF MARS. R.M. Goody. Journal of the British Interplanetary Society, v.16, no.2, Apr.-June 1957, p.69-83.

GULLIVER'S MOONS. Donald Malcolm. Spaceflight, v.1, no.3, Apr.1957, p.107-108.

SHOCK LAYERS IN DIFFERENT PLANETARY ATMOSPHERES. Joseph Charyk. Astronautics symposium, held in San Diego, Feb.18-20,1957, under sponsorship of Office of Scientific Res. and Convair. The presence or absence of various gases in the planetary atmospheres would depend upon atmospheric temperature and whether or not the root-mean-square thermal velocity was less than or greater than the planetary escape velocity.

EFFECTS OF ABNORMAL SOLAR ACTIVITY. Walter O. Roberts. Astronautics Symposium, held in San Diego, Feb. 18-20,1957, under sponsorship of Office of Scientific Research and Convair. Concerns two types of solar activity which result in changes in the environment in planetary atmospheres and all through the solar system. First abnormal activity is the solar flare, in

which you have a very high velocity jet radiating out from the surface of the sun and producing temperature effects up to about a million degrees Kelvin. The other abnormal activity appears as an irregularity in the solar corona.

PLANETARY ATMOSPHERES. George Solomon. Astronautics symposium, held in San Diego, Feb.18-20, 1957, under sponsorship of Office of Scientific Res. and Convair. Planetary atmospheric data is sparse and it is obtained by telescopic and spectroscopic means. He regards the temperatures commonly accepted to be fairly accurate but the density and composition of the atmosphere to be only order of magnitude estimates. Limitations of spectroscopic techniques in identifying compounds by band spectra is pointed out.

PRELIMINARY REPORT ON OBSERVATIONS OF MARS MADE AT MOUNT WILSON IN 1956. Robert S. Richardson. Spaceflight, v.1, no.3, Apr.1957, p.114. Journal of the British Interplanetary Society, v.16, no.1, Jan.-Mar.1957, p.1.

THE ATMOSPHERE OF THE PLANET MARS. Seymour Lester Hess. (Presented at meeting of Section on Jan.22, 1957). New York Academy of Sciences, Transactions, Ser. 2, v.19, no.4, Feb.1957, p.352-357. (CN-55257)

THE MOON - EARTH'S NEAREST NEIGHBOUR. E.A. Whitaker. Spaceflight, v.1, no.2, Jan.1957, p.52-60.

CLASSIFICATION OF SOLAR PROMINENCES. III - 1952. IV - 1949. Donald Howard Menzel and Shirley F. Jones. (Sponsored by Air Force Cambridge Research Center). Harvard College Observatory. Scientific Rept. 4 and 5, 1957. (CN-58018, pt.3 and pt.4)

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ATMOSPHERIC PHENOMENA AT HIGH ALTITUDES. Michigan U. This is a series of reports, first report covering period Aug.-Oct.1956. (SN-52936)

THE CHEMISTRY OF JUPITER. Frances Owen Rice. Scientific American, v.194, no.6, June 1956, p.119-120, 122, 124, 126. The big planet's varicolored markings are an old astronomical puzzle. The author now suggests that the colors may be due to free radicals, frozen in the very cold Jovian atmosphere.

LIGHT AND SHADE ON THE MOON. H. Percy Wilkins. Journal of the British Interplanetary Society, v.15, no.2, Mar.-Apr.1956, p.101-103.

SOLAR PHYSICS. Leo Goldberg and Donald H. Menzel. Smithsonian Contributions to Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.103-112. (CN-53300, v.1, no.1)

MINOR PLANETS. Paul Herget. Smithsonian Contributions to

Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.87-88. (CN-53300, v.1, no.1)

PLANETS, SATELLITES, AND COMETS. Gerard P. Kuiper. Smithsonian Contributions to Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.89-93. (CN-53300, v.1, no.1)

EXPLORATION OF MARS. Willy Ley and Wernher von Braun. New York, 1956.

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THE VOLCANIC THEORY OF MARTIAN GREEN AREAS. Alan E. Slater. Journal of the British Interplanetary Society, v.14, Nov.-Dec. 1955, pp.319-323.

NEW LIGHT ON THE CHANGING FACE OF MARS. Earl C. Slipher. National Geographic Magazine, v.108, no.3, Sept.1955, p.427-436. A huge green area almost the size of Texas appears in photographs made by the National Geographic Society-Lowell Observatory Mars expedition to South Africa.

ON INTERPLANETARY MAGNETIC FIELD. A. Beisler. Journal of Geophysical Research, v.60, no.2, June 1955, p.155-159. Considerations suggesting existence of interplanetary field; such field would not exceed about 5×10^{-8} gauss; its presence can explain observed cutoff in primary cosmic-ray momentum spectrum; field existing within earth's orbit can account for all or part of observed solar terrestrial time delays in aurorae and magnetic storms; other results.

PHYSICS OF THE PLANET MARS. Gerard de. Vancouleurs. Macmillan, 1955.

NEW FINDINGS ABOUT MARS. W.M. Sinton. Sky and Telescope, v.14, no.9, 1955.

ASTRONOMY. VOL. I - SOLAR SYSTEMS. VOL. II - ASTROPHYSICS AND STELLAR ASTRONOMY. Henry Norris Russell, R.S. Dugan, and J.Q. Stewart. Ginn and Company, 1955.

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RECENT RESEARCH ON THE MOON - I. OUR CRACKING SATELLITE. H. Percy Wilkins. Journal of the British Interplanetary Society, v.13, no.6, Nov.1954, p.313-318. This is the first of a series of articles on the Moon in which will be described the writer's most recent researches conducted with some of the largest telescopes. The present article deals with the mysterious clefts, or cracks, and presents evidence that these strange features may be on the increase.

THE TWO NEW TERRESTRIAL MOONS AND AMERICAN ASTRONAUTICAL POLICY. Wayne Proell. Journal of Space Flight, v.6, no.9, Oct.1954, p.1-5. Considers using the newly found moons as space stations as opposed to using an artificial satellite. (CN-59495)

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DEVELOPMENT OF A LUNAR BASE. G.E.V. Awdry. Journal of the British Interplanetary Society, v.13, no.3, May 1954, p.166-169.

WHERE TO LAND ON MOON. H. Percy Wilkins. Journal of the British Interplanetary Society, v.13, no.2, Mar.1954, p.65-67. Most suitable landing sites considered in light of author's personal observations with large telescopes; chart of such sites is attached and best spots for actual landings suggested; limitation of telescopic observation stressed; final decision is matter of selection on part of crew.

MARS, PLANET OF MYSTERY. N.J. Bowman. Journal of Space Flight, v.6, Jan.1954.

THE PHYSICAL CONDITION OF THE SOLAR CORONA. C.W. Allen. Physical Society of London. Reports on Progress in Physics, v.17, 1954, p.135-153.

EXPLORATION OF THE MOON. Arthur Charles Clarke and R.A. Smith. New York, 1954.

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INTERSTELLAR STRUCTURE OF THE ORION REGION - I. T.K. Menon. Astrophysical Journal, v.127, no.1, Jan.1958, p.28-47.

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THE ISOTHERMAL EXPANSION OF A GAS CLOUD INTO A NONUNIFORM ATMOSPHERE. M.H. Rogers. Archive for Rational Mechanics and Analysis, v.1, no.1, Sept.24,1957, p.22-34.

THE ABSORPTION OF RADIO WAVES IN SPACE. A.E. Lilley. Scientific American, v.197, no.1, July 1957, p.48. The hydrogen between the stars is explored by the 21-centimeter waves it absorbs.

THE RELATION BETWEEN PERIOD AND TIMES OF THE MAXIMA OR MINIMA OF VARIABLE STARS. Zdenek Kopal and Rudolf Kurth. Zeitschrift für Astrophysik, v.42, 1957, p.90-100.

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MOTIONS OF STARS OF TYPE A PERPENDICULAR TO THE GALACTIC PLANE. R.v.d.R. Woolley. Royal Astronomical Society: Monthly Notices, v.117, no.2, 1957.

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COLLIDING GALAXIES. Rudolph Minkowski. Scientific American, v.195, no.3, Sept.1956, p.125-132, 134. Many galaxies occur in clusters, the density of which is such

that their members may be expected to collide occasionally. The results are discussed here.

THE DISTRIBUTION OF GALAXIES. Jerzy Neyman and Elizabeth L. Scott. Scientific American, v.195, no.3, Sept.1956, p.187-188, 190, 192, 194, 197-198, 200. The light of galaxies takes so long to reach us that photographs of the deep sky map them both in space and time. Mathematicians now seek a chance mechanism that will account for their pattern.

RADIO GALAXIES. Martin Ryle. Scientific American, v.195, no.3, Sept.1956, p.204-208, 210, 212, 217-218, 220. As indicated earlier in the issue (Sept.1956) of Scientific American, colliding galaxies emit radio waves. The distribution of radio sources suggests that many are galaxies in collision beyond the range of the 200-inch telescope.

THE RED-SHIFT. Allan R. Sandage. Scientific American, v.195, no.3, Sept.1956, p.170-178, 180, 182. The redness, and presumably the speed of recession, of most galaxies increases regularly with distance. The most distant galaxies observed appear to depart from this law, a fact of deep meaning for cosmology.

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THE CLOUDS OF MAGELLAN. Gerard de Vaucouleurs. Scientific American, v.194, no.4, Apr.1956, p.52. Visible only in the Southern Hemisphere, they are the galaxies nearest our own.

ELECTRONIC PHOTOGRAPHY OF STARS. William A. Baum. Scientific American, v.194, no.3, Mar.1956, p.81. This new technique will enormously increase the effective power of telescopes.

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SOME OBSERVATIONAL PROBLEMS IN GALACTIC STRUCTURE. Harold Weaver. Smithsonian Contributions to Astrophysics, v.1, no.1, New Horizons in Astronomy, 1956, p.149-157. (CN-53300, v.1, no.1)

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THE SPIRAL STRUCTURE OF THE GALAXY. W.W. Morgan. Scientific American, v.192, no.5, May 1955, p.42-48. For some time, astronomers have known that the Milky Way resembled the spiral nebulae outside it. Now classical and radio astronomy have begun to draw a detailed picture of the far-flung galactic arms.

ON THE ORIGIN OF THE MAGNETIC FIELDS AND ANGULAR ROTATIONS OF STARS AND PLANETS. Winston Harper Bostick. Radiation Lab., U. of Calif. UCRL-4502, Apr.27,1955. Gravitational contraction of ionized material across a magnetic field produces an enhancement of the magnetic field and a rotational angular momentum of the mass. This process can conceivably explain the magnetic fields and rotations of galaxies, stars, and planets, and can possibly explain the expanding universe. (CN-48093)

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LEGAL ASPECTS

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SPACE LAW: THE DEVELOPMENT OF JURISDICTIONAL CONCEPTS. Andrew G. Haley. (Presented at 8th International Astronautical Congress, Barcelona, Oct.6-12,1957). American Rocket Society Preprint 508-57. It is unfortunate that the problem of space law has become involved in the proceedings of the United Nations Sub-Committee on Disarmament instead of being studied by the judicial bodies of the United Nations and ICAO. Factors which must be considered in defining the boundary of "air space" are indicated and the opinions of other authorities are reviewed. Other legal problems of astronautics are mentioned. (CN-58812)

LEGAL TERMINOLOGY FOR THE UPPER REGIONS OF THE ATMOSPHERE AND FOR THE SPACE BEYOND THE ATMOSPHERE. John C. Hogan. American Journal of International Law, v.51, no.2, Apr.1957. (CN-59513)

THE INTERNATIONAL SITUATION AND LEGAL INVOLVEMENTS WITH RESPECT TO LONG-RANGE MISSILES AND EARTH-CIRCLING OBJECTS. Andrew G. Haley. Astronautics symposium, held in San Diego, Feb.18-20,1957, sponsored by Office of Scientific Research and Convair. Space law includes a number of aspects, for instance, sovereignty over the air space and free space.

UNITED NATIONS, SPACE LAW AND METALAW. Andrew G. Haley. American Rocket Society Preprint 397-57, 1957.

SOME CURRENT CONSIDERATIONS AFFECTING THE EVOLUTION OF SPACE LAW. P. K. Roy. American Rocket Society Preprint 388-57, 1957.

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BASIC CONCEPTS OF SPACE LAW. Andrew G. Haley. Jet Propulsion, v.26, no.11, Nov.1956. American Rocket Society Paper 277-55. The development of the international law controlling activities in the air spaces above the earth today is discussed; a system of space law based on the principle of fundamental justice is explained and advocated; and steps which might be taken by existing international organizations -- especially in the field of communications -- are detailed.

LEGAL PROBLEMS OF UPPER SPACE. J. C. Cooper. Journal Air Law and Commerce, Summer 1956, p.308-316. Journal of the British Interplanetary Society, v.15, no.6, Nov.-Dec.1956, p.305-307. Importance of problem of legal status of space beyond atmosphere where rockets and satellites can be operated without undue atmospheric interference; it is suggested that some form of international agreement be adopted.

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THE PRESENT DAY DEVELOPMENT OF SPACE LAW AND THE BEGINNING OF METALAW. Andrew G. Haley and others. American Rocket Soc. Preprint 378-56, 1956.

PROJECTING THE LAW OF THE SEA INTO THE LAW OF SPACE. Chester C. C. Ward. American Rocket Society Preprint 377-56, 1956.

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LAW OF SPACE. C. E. S. Horsford. Journal of the British Interplanetary Soc., v.14, no.3, May-June 1955, p.144-150. Conquest of space and operation of man-made vehicles in it will raise many new problems of legal nature, both national and international; examination of some of these problems in light of modern international law and possible method of solution.

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THE LEGAL NATURE OF COSMIC SPACE. (Die rechtliche Natur des Weltraums). A. A. Cocca. (German text). Fifth International Astronautical Congress, Innsbruck, Aug.5-6,1954, p.283-290. (N-46768)

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JURIDICAL PROBLEMS OF SPACE FLIGHT. (Rechtliche Probleme des Weltraumflugs). Alex Meyer. (German text and English summary). Proceedings of the Third International Astronautical Congress, Stuttgart, Sept.1-6, 1952, p.19-29. A discussion of: 1. Legal character of outer space; 2. Legal obligations on occasions of space flight; 3. Legal treatment of the artificial satellite. (N-53323)

LEGAL ASPECTS OF SPACE TRAVEL. Oscar Schachter. (Presented on Oct.12,1951 at Hayden Planetarium Symposium on Space Travel, held in New York). Journal of the British Interplanetary Society, v.11, no.2, Mar.1952, p.57-60. Discusses problems and relevancy of astronautical studies to other fields of human knowledge.

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LEGAL CLAIMS IN SPACE. W. Chilcote. Journal of Space Flight, v.2, no.2, Feb.1950, p.1-3. Suggests two methods for protecting space station: 1 - "Logical civilized means," i.e., referral of dispute to an appellate court for settlement based upon international law, and 2 - Military protection of a major sort.

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EARTH SATELLITES, GUIDED MISSILES, ROCKETS, AND SPACE FLIGHT. Mildred Benton. Wilson Library Bulletin, v.32, no.6, Feb.1958, p.412-419. A bibliography of books and periodical articles. (N-58791)

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A BIBLIOGRAPHY FOR THE INTERNATIONAL GEOPHYSICAL YEAR. National Science Foundation, NSF 57-25, July 1,1957. (N-58667)

A CASEBOOK ON SOVIET ASTRONAUTICS, PART 2. F. J. Krieger. Rand Corp. RM-1922, June 21, 1957. "Russian technical literature--as inspection of the bibliographies in both parts of this casebook clearly indicates--contains a wealth of evidence on native competence in the various theoretical aspects of rocketry and space flight... Recent Russian technical lieterature given abundant evidence of continued progress in the various disciplines associated with space flight." Contains bibliography and 16 papers translated from Russian substantiating above statement. (CN-47550,pt.2)

SPACE ENCYCLOPEDIA. Edited by Harold Spencer Jones, R. H. Garstang. Patrick Moore, J. G. Porter, A. C. B. Lovell, Hubertus Strughold, Homer E. Newell, E. Burgess, M. T. Bizony and R. Griffin. Artemis Press, 1957, 287p.

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SPACE LAW BIBLIOGRAPHY. John C. Hogan. Air Law and Commerce, Summer 1956, p.317-325. (CN-59514)

A CASEBOOK OF SOVIET ASTRONAUTICS, PART 1. F. J. Krieger. Rand Corp. RM-1760, June 21,1956. Contents: The way to the stars, by V. Borisov. Flight to the moon, by M. K. Tikhonravov. Is a moon rocket being built in the Soviet Union? by H. H. Koelle. Trip to the moon: fantasy and reality, by K. Stanyukovich. Item on interplanetary communications from Bol'shaya Sovetskaya Entsiklopediya. On the way to the stars, by N. A. Varvarov. Problems of interplanetary flights, by K. Stanyukovich. Gold medal established for outstanding work in the field of interplanetary communications. Problems of cosmic flight, by A. A. Shternfel'd. Commission on interplanetary communications. Problems of flight into cosmic space, by N. Varvarov. Problems of astronautics, by V. G. Fesenkov. An artificial satellite of the earth, by K. Stanyukovich. Cosmic laboratory, by A. G. Karpenko. The artificial earth satellite, by G. I. Pokrovskii. Discovery of a world, by N. Varvarov. Problems of cosmic flights, by A. G. Karpenko and G. A. Skuridin. On flights into space, by L. I. Sedov. The road into the cosmos, by Yu. S. Khlebtsevich. Problems of weightlessness, by P. K. Isakov. A table of soviet missiles, by Alfred J. Zaehringer. This casebook is a preliminary attempt at uncovering

evidence of Soviet interest in astronautics and space flight. It consists of two sections. The first is a 4-part bibliography dealing with historical, scientific, and technical aspects of rocketry and astronautics; the second is a series of complete translations from Russian of articles by various authorities for a variety of periodicals and arranged chronologically so that the reader can appreciate the Soviet technique in developing the subject in the open literature and become acquainted with personnel engaged in Russian space flight studies. (CN-47550)

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A HISTORY OF THE ARTIFICIAL SATELLITE. Alan R. Krull. Jet Propulsion, May 1956, p.369-383. Chronological bibliography covering approximately 350 references and listing significant published literature on both manned and unmanned artificial satellites of the earth. (N-58682)

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FAMOUS RUSSIAN ENCYCLOPEDIA OF ASTRONAUTICS – PARTS 1, 2, AND 3. Reviewed by G. V. E. Thompson. Journal of the British Interplanetary Society, v.13, no.4, July 6, 1954, p.193-202; Nov., p.301-313. (Parts 1 and 2); Ibid. v.15, no.2, Mar.-Apr.1956, p.82 (Part 3). Account of contents of 9 volume work in Russian of N. A. Rynin, entitled Mezhplanetnye Soobshcheniya (Interplanetary Communications), published over the period 1929-1932. July - Dreams, legends and first fantasies; cosmic ships; radiant energy; rockets. Nov. -

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BIBLIOGRAPHY ON METEORITIC DUST WITH BRIEF ABSTRACTS. E. Dorrit Hoffleit. (Including compilation by Willard J. Fisher). Harvard Coll. Observatory, Tech.Rept.9, 1952. (N-21532)

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L'ASTRONAUTIQUE. Alexandre Ananoff. Paris, 1950, 498p. (629.1388 An1)

L'ASTRONAUTIQUE, LES ETAPES D'UNE SCIENCE NOUVELLE. Alexandre Ananoff. Science et Vie (Paris), Special Astronautical Issue, 1952, p.13-27. Chronological arrangement of names important in the history of rocketry and space travel.

L'ASTRONAUTIQUE D'HIER ET D'AUJOURD'HUI, ESPACES. Alexandre Ananoff. La Revue de l'Aviation, v.1, no.6, June-July 1946, p.8-14. Review of Noordung's project, Oberth's space mirror and rocket and general history of the subject.

SPACE RESEARCH AND EXPLORATION. D. R. Bates, Editor. William Sloane Associates, 1958. Contents: Rockets and rocket propellants, by J. Humphries. Exploration of the upper atmosphere, by D. R. Bates. Cosmic radiation and space-flight, by L. R. Shepherd. Meteor hazards beyond the atmosphere, by M. W. Ovenden. Earth satellite program, by H. S. W. Massey. Manned satellite station, by R. A. Smith. Interplanetary orbits, by D. F. Lawden. Difficulties of space navigation, by J. G. Porter. Medical and biological problems, by A. E. Slater. Conditions on the moon and nearer planets, by Patrick Moore. (629.1388 B31)

SATELLITE! Erik Bergaust and W. Beller. Foreword by Hermann Oberth. New York, 1956.

FIFTY YEARS OF RELATIVITY. Peter G. Bergmann. Proceedings of the 3rd American Astronautical Society, Dec.6-7,1956, p.135-155. The special and general theories of relativity and the significance of these concepts are reviewed. (N-58942)

SOME PARADOXES OF INTERSTELLAR TRAVEL. A. E. H. Bleksley. Journal of South African Interplanetary Society, July-Sept.1955, p.49-53.

ARTIFICIAL SATELLITE, UNIFICATION AND MECHANICS (SIDAR-MECHANICS). A. Boni. Astronautica Acta, v.1, no.3, 1955, p.120-136. Paper presented at the Fifth International Astronautical Congress, Innsbruck, Austria, Aug.5-7,1954, but not published in the proceedings. Discusses problems concerned with the artificial satellite.

THE EARLY STEPS IN THE REALIZATION OF THE SPACE STATION. Wernher von Braun. (Lecture given at the 2nd

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SPEECH MADE BY J. H. DOOLITTLE ON R. H. GODDARD - FATHER OF MODERN ROCKETRY. (Given at opening of Goddard Rocket Exhibit, American Museum of Natural History, New York, Apr. Apr.21,1948). Journal of American Rocket Society, no.74, June 1948, p.53-61. Some day we may be able to leave the earth entirely and fly to the moon, or even to a nearby planet, or set up an artificial orbit around the earth from which we can patrol the earth or carry on scientific research in space. Such dreams and ideas sound like pure fantasy; however, each advance in rocket research brings them closer to reality.

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